CONTENTS

Mobilization of ankylosed joints

by

W Russel MAC AUSLAND, M D
Surgeon in Chief Orthopedic Department
Carney Hospital Boston, Mass

INTRODUCTION

Much progress has been made in the surgery of bones and joints in recent years due largely to the extraordinary perfection of technical methods and the persistent efforts of a few able leaders Probably no section of this field has occupied so much interest and effort as the surgery of stiff joints

The best teaching until very recent years dealt almost entirely with the proper position in which a joint should be allowed to ankylose so as to permit the best function The shoulder *stiff in abduction* is certainly much better functionally than the shoulder stiff at the side of the body the knee *stiff in almost full extension* is undoubtedly far less of a disability than the knee fixed in marked flexion And yet with the gradual development of surgical technique certain pioneers in joint surgery have tried to increase function by different methods

Although the mobilization of ankylosed joints was at first and is even now attempted by only a few surgeons several good results arising in a sea of failures led the pioneers onward to develop this new field of surgery Foremost among them is the late Dr John B Murphy of Chicago to whom we pay a tribute of admiration for his constructive efforts founded on a vast accumulation of clinical and scientific material The results of operations have been sufficiently definite so that various methods may be presented with the assurance that they

will continue to be more or less standard in future work To Payr Putti and Baer persisting in the face of adversity h opened this limited field of surgery so that carefully tra operators with highly developed technical skill can now pr results which show only a small percentage of failures risk to life is very low and the margin of good results reason certain

ARTHROPLASTY NOT AN EXCISION

Arthroplasty or the operation of mobilizing ankylosed jo is not an excision Murphy has well said « Arthroplasty be functional must be stable and excision of joints re always in flail joints » A flail joint cannot be consider proper result from a plastic operation Excision has no pl in the surgery of weight bearing joints save to obtain ankylo nor would it be used in non weight bearing joints if it w not that flail joints may be stabilized by means of light ap ratus

Those who attempt to mobilize ankylosed joints r approach the work well trained must show great techn skill and above all must exercice judgment in their selec of cases if they would qualify for this work

I present the subject of arthroplasty to you therefore order to stress these important points

1 That excision of a joint does not constitute an ar plasty

2 That highly developed technical skill is absolutely ne sary

3 That the judgment in the selection of cases is very d cult

ANKYLOSIS

Types Infectious Non tubercular Traumatic

Ankylosis is the result of an infectious process or trauma The latter is usually a fracture dislocation with wide separ of fragments followed by excessive callus The ankylo these traumatic cases is usually a firm fibrous forma although occasionally a true bony ankylosis may result

The infectious process may be either acute or chronic In the former case the causative agent is usually the streptococcus the pneumococcus or the gonococcus In these infections the onset is sudden and the course severe ending usually in a bony ankylosis We may on the other hand have a slow insidious polyarthritic process The focus of infection is situated else where and the joint condition is caused by the hæmotogenous deposits in the joint either of attenuated bacteria or of toxins The primary focus is often difficult to locate The ankylosis results from adhesions both within and without the joint and is at least at first fibrous in character

Murphy (36b) believes every type of non traumatic joint inflammation is the metastatic manifestation of primary infec tion in some other part of the body Sometimes long periods elapse between the primary infection and the secondary arthri-tides Gonococci metastasis usually occur in eighteen to twenty days staphylococci in ten to fourteen days and strep tococci and colon bacilli in eight to ten days These metastatic joint infections are initiated with a chill and are not rheumatic in character

The synovia is first involved the serous surface of the mem brane is destroyed in large and small areas Up to a certain extent it may be repaired In extreme erosions subserous tissues bridge over the spaces between the serous erosions and adhesions result The gonococcus pneumococcus and strep tococcus may produce this condition Pathology shows thick porky infiltrations of the synovial membrane œdema of the subserous surfaces and injection of the surface toward the joint The cartilage is not affected at an early date In repair the proliferated epitheloid cells become obliterated

CAUSES AND EXTENT OF ANKYLOSIS IN RELATION TO MOBILIZATION

It is important to emphasize the necessity of determining the cause of ankylosis for it makes a great difference whether the ankylosed joint is the result of fracture or of disease or whether it is congenital

Infections either acute or chronic do not constitute a contra indication to the operation provided that the process has not

The infectious process may be either acute or chronic In the former case the causative agent is usually the streptococcus the pneumococcus or the gonococcus In these infections the onset is sudden and the course severe ending usually in a bony ankylosis We may on the other hand have a slow insidious polyarthritic process The focus of infection is situated elsewhere and the joint condition is caused by the hæmotogenous deposits in the joint either of attenuated bacteria or of toxins The primary focus is often difficult to locate The ankylosis results from adhesions both within and without the joint and is at least at first fibrous in character

Murphy (36b) believes every type of non traumatic joint inflammation is the metastatic manifestation of primary infection in some other part of the body Sometimes long periods elapse between the primary infection and the secondary arthritides Gonococci metastasis usually occur in eighteen to twenty days staphylococci in ten to fourteen days and streptococci and colon bacilli in eight to ten days These metastatic joint infections are initiated with a chill and are not rheumatic in character

The synovia is first involved the serous surface of the membrane is destroyed in large and small areas Up to a certain extent it may be repaired In extreme erosions subserous tissues bridge over the spaces between the serous erosions and adhesions result The gonococcus pneumococcus and streptococcus may produce this condition Pathology shows thick porky infiltrations of the synovial membrane œdema of the subserous surfaces and injection of the surface toward the joint The cartilage is not affected at an early date In repair the proliferated epitheloid cells become obliterated

CAUSES AND EXTENT OF ANKYLOSIS IN RELATION TO MOBILIZATION

It is important to emphasize the necessity of determining the cause of ankylosis for it makes a great difference whether the ankylosed joint is the result of fracture or of disease or whether it is congenital

Infections either acute or chronic do not constitute a contraindication to the operation provided that the process has not

stiff fingers third, stiff wrist (a very rare subject for arthroplasty) fourth the jaw, which demands arthroplasty

In general it may be said that definite indications naturally rest with the judgment of the surgeon but must depend to a large degree upon the patient One stiff elbow for instance, in some individuals is a very slight disability in others it is of supreme importance It is necessary therefore that each case be considered upon its merits and not upon the mere desire of a patient to be able to move a joint There should be considered constantly the question of whether the deformity may be actually the principal source of disability and whether as has been mentioned before correction of deformity may not give sufficient relief to the patient

METHODS OF TREATMENT

GENERAL SURVEY a) *Prior to Arthroplasty*

Many means have been used to gain mobility in ankylosed joints Previous to 1860 «brisement force» was the general method of treatment It is still in use and in properly selected cases the results are good

J Rhea Barton (1) of Philadelphia in 1826 first attempted pseudoarthrosis in the case of ankylosis of the hip joint The operation consisted of an osteotomy through the femur above the trochanter and the attempt to prevent bony union by movement The patient lived six years with a good weight bearing leg and some motion in all directions

Rodgers (2) of New York modified this method in 1830 by *removing a disc of bone from between the trochanters* He obtained a more satisfactory result Berard (3) Esmarch and Rizzoli both reported by Murphy (36) and Mollhenney (147) used similar methods for treatment of the jaw

In 1860 Wolff (11) recommended a method which he called arthrolysis which consisted of chiseling through and dividing all fibrous or bony adhesions without resection of the articular extremities that had been restored to their normal position Wolff claims favorable results in nine cases, four of ankylosis of the fibrous type and five of the bony type It is probable that he did not treat a true bony ankylosis

been tubercular or is not active It is well to point out that many joints apparently firmlyanhylosed even by a bony bridge may retain active infectious agents for a year or even two years A tubercular joint even when ankylosed firmly may retain small walled off foci throughout life and therefore except in cases of great rarity should be considered a direct contra indication to any mobilizing

Certain infections cause great destruction of bone and injury to the soft structures of the joint Where such destruction has been very extensive or where there has been marked scarring of the tissues a difficult operation may be expected

Occasionnally deformity of such extent is present as to warrant the correction of the deformity before arthroplasty is attempted The hip for instance ankylosed in marked flexion and adduction will present a very difficult operative problem unless the deformity is first corrected by a preliminary procedure Marked flexion of the knee although not so important may also necessitate a preliminary intervention

In general I have found bony ankylosis easier to deal with than partial or the so called fibrous types

INDICATIONS AND CONTRA INDICATIONS

Any ankylosed joint might be considered for arthroplastic procedure but there are definite limitations and therefore we come to have certain fundamental indications for arthroplasty

Major Joints

First two stiff hips will indicate arthroplasty on one hip or possibly both Second two stiff elbows will present the same indication Third two stiff knees will present a definite indication for an arthroplasty on one side at least Fourth combinations of hips and knees in the same individual a condition not infrequently seen in multiple arthritis is a very definite indication for attempting to mobilize one or more joints The surgeon considers in all of the above indications the anatomical and occupational status of the patient

Minor Joints

Among the lesser joints which may be considered properly a subject for intervention are First stiff shoulders second

cast from toes beyond the iliac crest followed Three months later the epiphyses were in firm union the semilunar cartilage preserved and the articular cartilage was smooth A small spicule of bone was later excised and analysed The trans planted portion had become a part of the new organism

The second case Lexer reported was a transplantation for bony ankylosis of a tubercular knee joint The entire joint was again taken from a freshly amputated limb In both cases the extremity was somewhat shorter The knee joint was in normal extension Lateral motion was present in the second case Both patients could bear their weight well when walking or standing Lexer then aimed to obtain function by muscle plastic elongation of the efficient non atrophic muscles

Herzberg (14) reported four cases in which transplantation of joints was done after resection Three of the cases were chil dren

Eloesser (15) reported a case of implanting a cadaveric joint consisting of 3 of tibia fibula and astragalus The attendant dropped the implant during the operation which necessitated heating it Suppuration developed and the foot was amputat ed Examination showed the tibia was invaded by new bone in all stages of formation In a case of implanting a finger joint from the cadaver 35° active motion and 60 passive was secured Movement was improving at the time of the report

Goebell (16) implanted a toe-joint into finger resected for severe arthritis deformans A good movable finger resulted and the patient a violinist resumed her profession

G T Vaughan (17) of Washington was unsucessful in re placing a knee taken from the cadaver The graft became the site of suppuration

Kuttner (18) reported two cases of implantation of femoral neck and head using the cadaver as the source of material One patient walked without a cane and had considerable motion An autopsy at death from vertebral metastasis one year and one month after operation showed the joint fixed to the femoral shaft by a narrow ring of bony callus The whole graft was covered by a membrane similar to periosteum The second case remained cured three years and two months Local recurrence necessitated disarticulation of the hip

Kocher (118) suggested dislocating the joint for a short period after arthrolysis No success is reported

Actual resection has a few advocates Good functional results have been reported in a proportion of cases of ankylosis of the jaw elbow and hip Konig (144) recommended resection in wide luxation Textor (199) in 1843 reported a case of ankylosis of the elbow in which there was full range of motion six years later Ferguson (178) secured a weight bearing limb by resection of the knee Dautrelepont (192) Czerny (190) and others observed that a new joint cavity with synovial membrane and articular cartilage formed three years after resection Sayre (12) and Defontaine (193) tried to fit bony ends after the fashion of an articulation They obtained stability but adhesions formed again Dartignes (191) described a trochleariform osteotomy he resected the joint surfaces with preservation of heir form The result was ankylosis again Cavazzani (179) liked to spare the bone and soft parts for the preservation of the physiological function He emphasized a transverse incision

Painter (185) recommended excision for in arthroplasty he feared the extrusion of the interposed material or infection Resection cannot however increase function in a weight bearing joint as the one essential — stability — is lacking and while resection in the upper extremity is practised and is as good as a poor arthroplasty it does not measure up with a good arthroplasty either in surgical technique or in functional result

Very little has yet been done in the transplantation of half or whole joints Lexer s (13) first case was to implant in a stiff elbow of gonorrheal origin the patellar surface of the femur The result was fibrous ankylosis His next step was to use a transplant of the entire knee joint The knee joint was fix in acute flexion in bony ankylosis resulting from articular puration after purulent osteomyelitis of the femur He n an anterior flap incision the soft parts remaining in c r with the flap All lateral and posterior coverings w tached A new joint obtained from a limb amputat taneously for senile gangrene (without phlegmon) w In this ca e he neglected to place tissue beneath th patella thus necessitating a second interference Fixati n by plaster

used magnesium plates and silver Chlumsky (25) tried zinc and rubber, but reported no permanent results Later he used absorbable plates of decalcified bone ivory and magnesium but the results on the whole were not satisfactory Gluck (30) and others inserted ivory pegs Besides these materials celluloid gutta percha and temporary packings of gauze have been used Foderl (179) in 1903 used animal membrane or walls of ovarian cyst but found that they caused suppuration and re ankylosis occurred

Rechet (4) covered the ends of the resected bones in various joints with periosteal flaps

Hofmann (5a) in 1906 reported a case in which he trans planted periosteal flaps from the tibia to the resected ends of the bones of the elbow He obtained full extension and flexion to 80°

Von Frisch (7) used periosteal grafts from the tibia in an elbow ankylosed from gonorrheal arthritis Only 25° mot on was obtained The author attributed the result to lack of after treatment

Greiffenhagen (8) reported three cases in which periosteum was used in elbow jonts

A graft 6f joint cartilage was first used with success by Tuffier (198) in 1901 for a comminuted fracture of the upper end of the humerus Judet (137) doubled the cartilage with a layer of bone

Mauclaire (9) used cartilage from the astragalus to cover the rough ends Later the X Ray showed these fused to the bone

Weglowski (6) in 1917 reported a case in which he used successfully cartilage from the rib in an ankylosed elbow

More recntly cartilage grafts were used by Delageniere (10) after a resection had been done The operation showed no advantage over excision as some instability of the joint follow ed

Gluck (30) in 1902 used skin flaps

Diel (194) reported the use of reindeer tendon and the epi ploon of a rabbit in a case of femoral patellar ankylosis In ten months the patient could walk easily without a cane

Deutschlander (195) tried transplanting in a child of thirteen a graft containing the joint extremities of the femur and tibia with the greatest part of the joint capsule menisci and ligamentous apparatus Ten months after the operation the transplant was luxated and removed

Oehlecker (184) in 1922 reported the outcome after six years of eight cases in which an entire joint was transplanted into a finger In four cases the joint was taken from the patient himself and in others from another person The results in the autoplastic cases were more successful

Work with whole and half joints has been done by Sievers (165) Petraschewskaja (187) Katzenstein (141) and Buchmann (175)

There is much discussion in regard to the regeneration process Axhausen (19) in 1907 proved that periosteum and endosteum of implants remained alive Eloesser (15) believes regeneration takes place in part from the elements of the graft itself

The cadaver material is easier to obtain than a living graft but infection must be avoided The joint is removed within twelve hours after death The Wassermann test is used on the blood and part of the bone marrow is incubated in broth The joint is implanted in Ringer s solution for twenty four hours It is then freed of all adherent tissue and muscle

In the operation a horseshoe flap is outlined and the bone is sawed close to the joint The new joint is inserted by mortising and held in place by catgut Traction is secured by adhesive plaster strips A plaster of Paris splint is then applied General passive motion is instituted in a week

This surgical procedure seems at once radical and dangerous and has not been generally accepted Simple arthroplasty without the use of bone transplants and with little use of any foreign heterogeneous material has supplanted all such extravagant measures Their interest is chiefly historical

Various non absorbable materials have been tried as the interposed material Carnochan (47) of New York in 1840 inserted a piece of wood in an ankylosed jaw Orlow (23) in 1901 used gilded aluminium plates in two jaw cases Roser (123) Pupovac (75) Huebscher (135) Hoffa (24) and others

formed during this process Allison and Brooks (39) found that the end results of simple resection of joint surfaces without interposition of a substance do not differ materially from cases in which the substance was inserted

Murphy (36g) destroyed joint surfaces and interposed flaps of fat and fascia He claimed that the fat undergoes connective tissue changes which facilitate the bursa formation

Neff (40) reports only one successful case of four arthroplasties on dogs using free transplants from the rectus aponeurosis Three cases were ruined by wound infection The successful operation on the knee showed new capsule had formed connective tissue between the tibia and femur and that two bursal sacs had developed

Davis (41) in his experiments on a dog found at autopsy that free fascia in the knee joint was adherent to the end of the femur and the material was viable Putti (50d) also used free fascia and found the substance retained normal characteristics

Kolazek (42) in five experiments on dogs excised a portion of the capsule and inserted homo transplants of peritoneum They healed and formed no adhesions

Sumita (43) destroyed the joint surfaces of the knee hip and ankle of twenty dogs and interposed pedicled flaps of muscle fascia and tendon The dogs were observed for periods of twenty one to two hundred forty four days Fibrous tissue and small cavities had formed but the largest cavity measured only 1 5 cm in diameter

Bolognesi (174) in a long series of experiments followed the process of formation of periarticular nearthrosis He believed that an enarthrosis or a true diarthrosis can be formed only when a foreign element is interposed and that the means of covering the cavity had origin in the cartilage of the neoformation which covered the free fragments of the fracture

Segale (161) in 1913 in experiments found that the joint capsule in a rabbit or dog reproduces itself from the surrounding tissues and forms a new capsule which limits the joint cavity and contains synovia The reproduction of the joint surroundings is closely connected with the operative technique which provides for the preservation of those parts which assure a correct joint mechanism

History of arthroplasty

Foreign substances are no longer used and since 1900 fat muscle fascia or specially prepared membranes have been inserted in the joints

The first case of muscle interposition was in the jaw where immobility often interferes with life In 1860 Verneuil (20) interposed a piece of temporal muscle and fascia between the condyle and glenoid after resection Helferich (21) and Ollier (22) developed the technique of muscle implantation and gave it general notice In 1893 Helferich exhibited a child who had regained motion in an ankylosed jaw by use of a flap of temporal muscle Lentz (145) Henle (134) and others repeated the operation using muscle flaps Both coronoid process and condyle of the inferior maxillary were removed by Bilczynski (27) and Hoffa (24) and a flap of temporal muscle inserted

In 1895 Mikulicz (29) used a flap from the masseter muscle instead of from the temporal Kusnetzow (29) repeated the operation performed by Hoffa and Bilczynski using a masseter flap as the interposed substance Rochet (155) and Schmidt (160) after the removal of the entire ramus interposed a masseter flap

Operations on other joints followed those of the jaw In the treatment of the elbow Quenu (32) Albarran (33) Nelaton (34) Delbet (35a) Murphy (36) Hoffa (24) and Schanz (48) used flaps from a muscle contiguous to the joint Berger (37) in 1903 mobilized a fibrous ankylosis by inserting a flap of the anconeus which he sutured to the brachialis anticus Huguier (31b) introduced in the radio ulnar joint a layer of the posterior ulna

Muscle flaps were then used by Rochet (155) Nelaton (34) and Hoffa (24) in ankylosis of the hip and others used them in the knee

EXPERIMENTAL METHODS

Unfortunately the experimental work in arthroplasties on animals has been relatively small

Experiments with living tissue have shown that it degenerates or is substituted by a fibrous tissue Small cavities are

formed during this process Allison and Brooks (39) found that the end results of simple resection of joint surfaces without interposition of a substance do not differ materially from cases in which the substance was inserted

Murphy (36g) destroyed joint surfaces and interposed flaps of fat and fascia He claimed that the fat undergoes connective tissue changes which facilitate the bursa formation

Neff (40) reports only one successful case of four arthroplasties on dogs using free transplants from the rectus aponeurosis Three cases were ruined by wound infection The successful operation on the knee showed new capsule had formed connective tissue between the tibia and femur and that two bursal sacs had developed

Davis (41) in his experiments on a dog found at autopsy that free fascia in the knee joint was adherent to the end of the femur and the material was viable Putti (50d) also used free fascia and found the substance retained normal characteristics

Kolazek (42) in five experiments on dogs excised a portion of the capsule and inserted homo transplants of peritoneum They healed and formed no adhesions

Sumita (43) destroyed the joint surfaces of the knee hip and ankle of twenty dogs and interposed pedicled flaps of muscle fascia and tendon The dogs were observed for periods of twenty one to two hundred forty four days Fibrous tissue and small cavities had formed but the largest cavity measured only 1 5 cm in diameter

Bolognesi (174) in a long series of experiments followed the process of formation of periarticular nearthrosis He believed that an enarthrosis or a true diarthrosis can be formed only when a foreign element is interposed and that the means of covering the cavity had origin in the cartilage of the neoformation which covered the free fragments of the fracture

Segale (161) in 1913 in experiments found that the joint capsule in a rabbit or dog reproduces itself from the surrounding tissues and forms a new capsule which limits the joint cavity and contains synovia The reproduction of the joint surroundings is closely connected with the operative technique which provides for the preservation of those parts which assure a correct joint mechanism

Ely (44) experimented on nineteen dogs using no interposing material Bony ankylosis developed in one case in four hundred thirty two days

Hohmeier and Magnus (45) in a series of experiments on dogs found the end results were the same with or without interposing substances

Beye and Steindler (46) experimented on dogs and found no adhesions formed after mere scraping of the cartilage covering and inserting of fascia Pedunculated muscle fascia was transformed into a connective tissue pannus adherent to denuded areas of bone There was complete transformation into connective tissue and no traces of original muscle fibres existed

Experiments were then made using non absorbable materials but they were discarded

Allison and Brooks (39) found that the chromicized pig s bladder suggested by Baer caused reaction in the surrounding tissues and adhesions formed They experimented with silver impregnated fascia and found relatively little reaction in the surrounding tissues

Phemister and Miller (188) obtained similar results in the elbows and knees of dogs with or without the interposition of free or pedunculated flaps The flaps largely broke down and the resulting joints were alike in the three types of operation They did not see how any appreciable amount of nutrition can be furnished by the circulation through the pedicle They believed that the circulation in the surviving portions is through adhesions to the parts with which they come in contact

PRESENT CLINICAL METHODS

The methods in use today as outlined by Murphy (36) Payr (74) Baer (38) Allison and Brooks (39) Putti (50) and the writer (81) have in common the exposing of the joint surfaces modeling of the bone ends after the conformation of the normal joint and the interposition of a substance to obstruct effectively bony union They differ particularly in the substance interposed

The two essential features of the Murphy treatment are the interposition of the pedicled fat and fascia flap and the appli

cation of traction Murphy (36) emphasized the inclusion of the fat as he believed it essential to a new joint foundation It was his belief too that the flap was nourished through the pedicle His technique in the different joints varies not in principle but as necessitated by the different joints It will accordingly be treated later under each joint The writer believes that pedunculated flaps are entirely unnecessary and when covered with fat they interfere with the highest technique

Baer (38) objects to the interposition of muscle or fascia for several reasons He maintains that the structure of the joint is interfered with when a bulky substance is inserted that too large an excision is required that if too little muscle or fat is interposed ankylosis results that the pain is severe due to the pressure on the nerve endings that the motion obtained is generally unnatural in character and that periarticular tissues are interfered with

Dr Baer advised chromicized pig s bladder as the transplanted medium It is thin and flexible and conforms accurately to the surfaces of the modeled bones and is tenacious enough to withstand disintegration for a period of from sixty to one hundred days

The use of Baer s membrane has not become universal on account of numerous failures and sloughing out of membrane often weeks and months after the healing of wounds Allison and Brooks (39) found that with Baer s membrane the reaction of the surrounding tissues was of such intensity that adhesions formed In 1913 they recommended the use of silver impregnated fascia from which there was relatively little reaction

In the use of the « free flap » as the interposing material there is an opportunity to obtain the correct size to determine the presence of a bursa and to secure a good layer of fatty tissue Putti (50) states that fascia will live after transplantation there is therefore no need to use pedunculated flaps He believes the free fascia grows and is transformed into a tissue like the synovia He covers the epiphysis completely with free aponeurotic flaps from fascia lata One difficulty he has met in the use of these flaps is necrosis of the edges a condition existing even in satisfactory cases

Putti has been particularly successful in his operations on

the knee I shall treat his technique under the division on the knee joint

Payr (74b) advises the careful extirpation of the capsular tube leading to the nerve-endings the removal of the masses of connective tissue is not enough Under the influence of the rapidly resumed function there develop in and between the interposed soft portion (fat or fascia etc) at first multiple and later connected interstitial spaces which finally form a joint space A new satisfactory capsular tube is formed out of the periarticular connective tissue in which other accessory liga ments may develop by simple mechanical exercises The new joint contains a synovial like fluid

Payr has obtained the best results with pedunculated flaps and freely transplanted fat In all cases Payr has found that the operation has increased the breadth of excursion of the joint motion Patients with an ankylosed knee leaving the hospital with 65° active mobility showed 90 or more after a year or so The movement is usually smooth and painless The X Ray showed the newly formed joint to be smooth and sharply defined there are no free bodies From a functional point of view also the new joints are satisfactory He advises being careful in operating for ankylosis of tubercular origin

Payr s technique is recommended by Wollenberg (169) who however warns against the general use of arthroplasty as too often mobility is purchased at the cost of an unstable joint

The writer (81a) first used free fascia in an ankylosed elbow in 1908 In 1914 four cases of free fascia transplants with excellent stable joints resulting were reported before the Ortho pedic Section of the American Medical Association in Detroit A series of thirty one cases of elbow arthroplasties was report ed in 1921

Ritter cf Thom (49) Behn reported by Harris (71) Kirsch ner (130) and others have also used free flaps

ELBOW

Most joints when stiff can be placed in a position to func tion well The position in which maximum function is obtain ed in the elbow is near 90° and many surgeons advocate it in preference to a mobilized joint But ankylosis of the elbow

joint even at this most satisfactory angle has very objectionable features

While function may be present if the elbow joint is ankylosed in flexion it is never good function and the arm is always in the way Usually too ankylosis is found in extension of about 160° in which position the arm is awkward although not unsightly Given then an ankylosis of the elbow-joint from any cause except tuberculosis some type of mobilization operation may be considered indicated

Resection which is performed for the tubercular joint in adult patients is the operation which is usually thought of first The results from this procedure are very unsatisfactory as the joint becomes flail weak and usually requires external support in the form of a leather armlet with limited elbow-joint motion Excision therefore is rather a crude surgical procedure and the ultimate results from its use do not warrant its being considered for any condition except tuberculosis of the elbow

For many years the writer has been working to improve the method of procedure in these cases and has found that with each improvement in the technique a definite improvement in the function of the elbow joint motion is obtained until finally the operation which is at present employed namely a true arthroplasty has been evolved

A good arthroplasty gives a smooth gliding joint so frequently emphasized by the late Dr John B Murphy The range of motion is excellent the strength approaches normal the stability is normal and the joint is painless and tends to stand rather severe work without showing arthritic changes

To my mind therefore the operation of arthroplasty on the elbow is to be considered in a different category from the old operation of excision I however wish to emphasize four important points first the necessity for the proper selection of the case second careful preparation for operation third strict adherence to the technique of the operation and fourth proper after care No arthroplastic method should be attempted until two years afeter an infectious process has been quieted down and until at least one year after a traumatic ankylosis These two groups include fractures infectious arthritis and a few neisserian joints

the knee I shall treat his technique under the division on the knee joint

Payr (74b) advises the careful extirpation of the capsular tube leading to the nerve endings the removal of the masses of connective tissue is not enough Under the influence of the rapidly resumed function there develop in and between the interposed soft portion (fat or fascia etc) at first multiple and later connected interstitial spaces which finally form a joint space A new satisfactory capsular tube is formed out of the periarticular connective tissue in which other accessory liga ments may develop by simple mechanical exercises The new joint contains a synovial like fluid

Payr has obtained the best results with pedunculated flaps and freely transplanted fat In all cases Payr has found that the operation has increased the breadth of excursion of the joint motion Patients with an ankylosed knee leaving the hospital with 65 active mobility showed 90 or more after a hear or so The movement is usually smooth and painless The X Ray showed the newly formed joint to be smooth and sharply defined there are no free bodies From a functional point of view also the new joints are satisfactory He advises being careful in operating for ankylosis of tubercular origin

Payr s technique is recommended by Wollenberg (169) who however warns against the general use of arthroplasty as too often mobility is purchased at the cost of an unstable joint

The writer (81a) first used free fascia in an ankylosed elbow in 1908 In 1914 four cases of free fascia transplants with excellent stable joints resulting were reported before the Ortho pedic Section of the American Medical Association in Detroit A series of thirty one cases of elbow arthroplasties was report ed in 1921

Ritter cf Thom (49) Behn reported by Harris (71) Kirsch ner (130) and others have also used free flaps

ELBOW

Most joints when stiff can be placed in a position to func tion well The position in which maximum function is obtain ed in the elbow is near 90° and many surgeons advocate it in preference to a mobilized joint But ankylosis of the elbow

and interposed a flap of fat from the under side of the forearm Three months after the operation the arm could be used for ordinary purposes

Murphy (36 a) first mobilized the elbow by his method in 1904 in a case of ankylosing arthritis A pyriform flap of deep fascia was dissected from the posterior surface of the triceps The flap was 4 1/2 long by 2 wide at its upper end and received its blood supply from a broad pedicle which remained attached to the muscle and fascia just below the level of the olecranon After the bony parts had been remodeled the fascia was drawn down and turned into the joint around the inner margin of the olecranon The proximal portion of the flap covered the trochlea lined the olecranon depression and the lesser sigmoid cavity while the distal portion covered the external condyle Subsequent events showed that the flap was not carried sufficiently high on the anterior surface of the humerus to permit adequate flexion of the joint Five months later the patient could pass his hand through an arc of 5 Pronation and supination were about one half normal His second case was reported two months after operation The hand could be moved through an arc of 3 and the elbow forcibly flexed to an acute angle and extended to 160° Pronation and supination were approaching normal

Hoffa (24) in 1905 reported a series of arthroplasties seven of which were on the elbow One using a magnesium plate was unsuccessful owing to formation of gas in the joint A fistula resulted which closed only when the plate was removed The operations in which fat fat and fascia and fascial flaps were used were all successful In two of them ankylosis followed scarlatina in the others gonnorrheal infection

In 1905 Quenu (32c) reported a third case in which there was great atrophy of the muscles He used for a flap the inner part of the triceps sutured to the anterior ligament Passive movements were begun in ten days and later electrical treatment was used As active movement was incomplete at the end of two months he made a second intervention to recover a part of the tendon of the triceps of which a large portion had been sacrificed He cut the portion interposed close to the bone He could then ascertain that there was no adherence between the

Ankylosis of tubercular origin requires other treatment and arthroplasty is indicated in only the most unusual case

There have been more arthroplasties on the elbow than on any other joints One of the early cases of arthroplasty using a muscle flap was reported by Albarran (33) Ankylosis had followed operative reposition A partial resection was done by which a good immediate result was obtained but later ankylosis occurred again A third operation was undertaken which consisted of a resection of the olecranon and interposition of a muscle fascia flap of the triceps After two years there was a range of motion from 65 to 115

Nelaton (34) in a case of ankylosis following neisserian infection resected an elbow and interposed a flap of the brachialis anticus Two years after the operation flexion and extension were normal but pronation and supination were much decreased Active extension required the weight of gravity

In 1903 Quenu (32b) reported an arthroplasty of the elbow for an ankylosis following a severe trauma of the arm consisting of a fracture of both bones of the forearm and destruction of the soft parts After resection he interposed a tendon fascia flap There resulted flexion to a right angle and good but incomplete extension There was good pronation but difficulty in maintaining an intermediate position The patient died of pulmonary tuberculosis a few months after the operation

Delbet (35a) also reported mobilizing an elbow in a girl of six which had become ankylosed in infancy resulting in complete atrophy of the arm At his first operation he resected the joint without breaking up the ankylosis Two months later after re-ankylosis he intervened again removing the bony spicules that had formed 0 5 cm thick from the humerus radius and ulna Some fibers of the flexor carpi ulnaris were interposed Chloroform mobilization was necessary a month later but the final result was good with flexion to a right angle and extension nearly complete

Schanz (48) in 1904 reported a mobilization of a bony ankylosis following rheumatism After chiseling through the joint he enlarged the sigmoid fossa removed a piece of the trochlea

and interposed a flap of fat from the under side of the forearm Three months after the operation the arm could be used for ordinary purposes

Murphy (36 a) first mobilized the elbow by his method in 1904 in a case of ankylosing arthritis A pyriform flap of deep fascia was dissected from the posterior surface of the triceps The flap was 4 1/2 long by 2 wide at its upper end and received its blood supply from a broad pedicle which remained attached to the muscle and fascia just below the level of the olecranon After the bony parts had been remodeled the fascia was drawn down and turned into the joint around the inner margin of the olecranon The proximal portion of the flap covered the trochlea lined the olecranon depression and the lesser sigmoid cavity while the distal portion covered the external condyle Subsequent events showed that the flap was not carried sufficiently high on the anterior surface of the humerus to permit adequate flexion of the joint Five months later the patient could pass his hand through an arc of 5 Pronation and supination were about one half normal His second case was reported two months after operation The hand could be moved through an arc of 3 and the elbow forcibly flexed to an acute angle and extended to 160 Pronation and supination were approaching normal

Hoffa (24) in 1906 reported a series of arthroplasties seven of which were on the elbow One using a magnesium plate was unsuccessful owing to formation of gas in the joint A fistula resulted which closed only when the plate was removed The operations in which fat fat and fascia and fascial flaps were used were all successful In two of them ankylosis followed scarlatina in the others gonnorrheal infection

In 1905 Quenu (32c) reported a third case in which there was great atrophy of the muscles He used for a flap the inner part of the triceps sutured to the anterior ligament Passive movements were begun in ten days and later electrical treatment was used As active movement was incomplete at the end of two months he made a second intervention to recover a part of the tendon of the triceps of which a large portion had been sacrificed He cut the portion interposed close to the bone He could then ascertain that there was no adherence between the

superior surface of the interposed segment and the inferior cut surface of the humerus The same condition existed on the inferior surface The tendinous segment had left a distinct cavity The tendon of the triceps was sectioned and re inserted on a little fibrous flap previously dissected on the forearm The patient gained not quite complete extension and flexion to a right angle

Dupuy (51) in 1905 reported five arthroplasties Three were done by Jeannel one by Kirmisson and one by Launay Jeannel used flaps of the brachialis anticus Kirmission of the biceps Launay a flap from the anterior ligament and the brachialis anticus In all cases good results were obtained

Huguier (31a) in 1905 reported two cases operated on by Nelaton with the interposition of a muscle flap In one case he gained good motion Huguier reported a third case by Ombredanne using the same method

Pereira (52) in 1916 in an unreduced subluxation resected the ends of the bones and interposed a flap of triceps muscle with an almost perfect functional result

Scudder (53) in 1906 1907 and 1908 reported several successful cases in which he used Murphy s method

In 1907 Bazy (54) reported a case in which he used a flap from the brachialis anticus Nine months later the function of the arm was almost perfect

Amevaga (152) in 1907 brought his method of treatment to general attention The two main factors of his technique are the formation of a new socket in the humerus and the firm grasp of the humerus by the hook of the ulna One difficult case he reported had a good success the patient in three years working in a factory and carrying heavy weights

Stein (55) in 1907 cited three successful cases from Bier s clinic Triceps flaps were used

Wiener (56) in 1909 treated an elbow ankylosed as a result of fracture A flap of fascia and subcutaneous fatty tissue from the triceps was inserted Twenty days after operation he broke up the adhesions Eighteen months later the patient could carry heavy bundles and motion was improving

Huguier (31b) in the same year mobilized an elbow using a flap of brachialis anticus In sixteen months the patient could

touch his shoulder with the hand and extend the forearm to 150°

Cifuentes (57) reported in the same year a similar arthroplasty in which one month after the operation he obtained a good functional result with normal movements

Reiner (58) in 1910 reported a series of twenty eight arthroplasties twenty five of which were given in full with the after results Two others, recent cases were reported with good immediate results In three cases the histories were unknown Of the others nineteen had useful arms although one was a flail joint which lacked power but could be controlled by the muscles The poor results in the other cases were due to extreme atrophy of the muscles and to extensive resection of the diseased tissue Re ankylosis occurred in two cases In one it was due to operation too soon after trauma a fracture luxation and lack of after treatment In the other case Reiner attributes the result to the disease myositis ossificans

Thom (49) in 1910 reported a case of ankylosed elbow operated on by Ritter He used freely transplanted fascia lata as an insert after the parts had been made freely movable On discharge there was 65 flexion and 100 extension Pronation and supination which were very slight before the operation were unchanged

Wille (127) in 1911 interposed supinator longus fascia with good results gaining 95 motion

Osgood (59) in 1911 reported a case of elbow operation using Baer s membrane Four months after operation extension was complete there was voluntary flexion to 120 and a little more than normal « lateral mobility » (Just what Osgood means by lateral mobility is hard to understand as a good arthroplasty has none)

Whitman (60) reported two cases of arthroplasty of the elbow in which he used Murphy s method

Edmunds (61) in 1912 reported an elbow ankylosis following fracture in which this method was also used At the time of the report active motion was not possible on account of the great atrophy of the muscles

Denk (62) reported two of von Eisenberg s cases in which elbow joints were mobilized with free fascia transplants with good functional results

Neff (40) reported a case in which he interposed a pedunculated triceps aponeurosis flap between the humerus and ulna and the radius and ulna Seven months after the operation there was active painless motion of 180 and 30° and only slight lateral mobility The joints of the wrist and hand which were previously partially ankylosed regained from one third to one half their normal range of mobility with the return of function to the elbow

Delbert (63) in 1912 reported having done nine resections of the elbow with articular grafts Most of these were too recent to determine the results but he reported in detail two cases of a year s duration in which the results appeared to be permanent In one of these he used cartilage from an ankle joint in the other cartilage from an elbow Both gave good functional results

Chaput (64a) reported three cases in which he resected from the thigh a flap of fat the size of the palm and encapsulated the lower end of the humerus with it suturing it to the neighbouring muscle by anteroposterior and lateral sutures

Conrad (66) in 1912 published a dissertation on the use of muscle flaps as interposing material I have been unable to obtain a copy of this thesis

Pomponi (67) advocated the use of a pedunculated fascial flapy by the method of Durante He cited one case in which he gained complete pronation and supination nearly normal extension and flexion to 60

Murphy (36b) reported twelve arthroplasties on the elbow using pedunculated fat and fascia flaps

Mauclaire (9) mobilized an elbow using cartilage from the astragalus to cover the defects One fragment was put on the lower end of the humerus and another between the radius and ulna A roentgenogram later showed these grafts fused to the bone

Putti (50a) in 1913 reported his arthroplasties to date These included twelve elbow cases in which he used Kocher s incision and a free flap of fascia lata He obtained stable joints with a useful degree of motion

Roepke (68) reported ten cases of ankylosis of the elbow in which he did arthroplasties using free fat flaps to interpose

between the joints He advised against beginning passive motion too soon One case of arthritis deformans was shown in 1911 before the Medical Society of Jena In others the ankylosis had resulted from trauma neisserian infection and tuberculosis

Exner (69) reported a case fourteen months after an arthroplasty in which a free flap of fascia lata was interposed The arm was somewhat unstable but gave good function The patient could lift heavy weights At the same time Pupovac reported a second case by the same method

Darling (70) reported an arthroplasty with the use of a pedunculated flap done in the presence of active infection The immediate result was good

Harris (71) in 1914 reported two elbow cases by the Murphy method In one he gained 75° motion In the other there was 60 motion

Turner (72) reported an arthrosplasty of the elbow for an ankylosis following a severe osteomyelitis There had been a musculospiral paralysis from which the patient made a perfect recovery The elbow had entirely healed, but at the time of operation a small area of latent infection was found Turner used a posterior skin incision and inserted a flap of fascia lata The elbow was put up in extension The next day there was a recurrence of the paralysis with signs of local infection Later fearing re ankylosis he manipulated the elbow under ether into extreme flexion Six months later the boy had motion from 50° to 120° and a useful arm though the muscles were still atrophied

Murphy (36c) in the same year cited two cases operated on by his usual method One patient left the hospital in five weeks with free flexion and extension within an arc of about 45 The other patient one year after the operation had motion to 120°

Vulpius (73) prefers pedunculated flaps but also uses free flaps of fat or fascia and fat or Baer s membrane

Durante (122) in 1914 interposed a flap of the sturdy aponeurosis taken from the foream This method is indicated particularly in extended and hyperextended ankylosis and in cases at a right angle

Neff (40) reported a case in which he interposed a pedunculated triceps aponeurosis flap between the humerus and ulna and the radius and ulna. Seven months after the operation there was active painless motion of 180° and 30° and only slight lateral mobility. The joints of the wrist and hand, which were previously partially ankylosed, regained from one third to one half their normal range of mobility with the return of function to the elbow.

Delbert (63) in 1912 reported having done nine resections of the elbow with articular grafts. Most of these were too recent to determine the results, but he reported in detail two cases of a year's duration in which the results appeared to be permanent. In one of these he used cartilage from an ankle joint, in the other cartilage from an elbow. Both gave good functional results.

Chaput (64a) reported three cases in which he resected from the thigh a flap of fat the size of the palm and encapsulated the lower end of the humerus with it, suturing it to the neighbouring muscle by anteroposterior and lateral sutures.

Conrad (66) in 1912 published a dissertation on the use of muscle flaps as interposing material. I have been unable to obtain a copy of this thesis.

Pomponi (67) advocated the use of a pedunculated fascial flapy by the method of Durante. He cited one case in which he gained complete pronation and supination, nearly normal extension and flexion to 60°.

Murphy (36b) reported twelve arthroplasties on the elbow using pedunculated fat and fascia flaps.

Mauclaire (9) mobilized an elbow, using cartilage from the astragalus to cover the defects. One fragment was put on the lower end of the humerus and another between the radius and ulna. A roentgenogram later showed these grafts fused to the bone.

Putti (50a) in 1913 reported his arthroplasties to date. These included twelve elbow cases in which he used Kocher's incision and a free flap of fascia lata. He obtained stable joints with a useful degree of motion.

Roepke (68) reported ten cases of ankylosis of the elbow in which he did arthroplasties, using free fat flaps to interpose

degrees of motion Seven weeks after operation there was good pronation and supination and perfect freedom of motion

Ashhurst (77) uses an incision along the external supracondylar line and the external condyle detached from the humerus with an osteotome A pedunculated flap is inserted and the external condyle replaced by means of a Lambotte self boring screw He reports five cases In these cases there were three good end results One case had a flail joint with very slight power of extension The fifth case had a limited motion but the patient refused forcible manipulation

Gilbert (78) cited a case of dislocation of the elbow which existed three months Good use of the joint was obtained after a Murphy arthroplasty

Tubby (79a) reported on elbow case in which he used a muscle flap At the time of the arthroplasty insufficient bone was removed and re ankylosis took place Eight months later he did a secondary operation to remove the mass of new bone After this intervention all movements were free but the elbow was slightly flail

Chaput (64b) reported a case of arthroplasty for ankylosis following luxation of the elbow He used two lateral pedunculated flaps and sewed the skin up tight The arm was put up in a sterile dressing in extension The following day the arm was flexed and flexion was complete and vigorous He attributes the good result to sewing up the wound without drainage and to the immediate mobilization

Graff (181) described a case in which he interposed a flap of triceps muscle with almost complete return of normal motion

Kennedy (80) cited a case in which a pedunculated flap was used The end result is not reported

Murphy (36*d*) reported a case showing perfect motion seven months after arthroplasty for ankylosis from a fracture A second ankylosis from tuberculosis showed a good end result

Whitman (60) exhibited before the *New York Surgical Society* a case in which an arthroplasty had been done for a fibrous ankylosis following tuberculosis Four years before an arthroplasty had been done using a pedunculated flap At the second operation the fibrous ankylosis was found to have become bony Whitman used a flap of fascia lata at this operation He believes

Simon (166) in 1914 in operating for ankylosis in a position of extension of about 170 used a longitudinal incision and a pedunculated flap from the fascia of the upper arm The result was the ability to bend the elbow almost to a right angle and to extend it at least to 170

Payr (74a) emphasizes the importance of removing the capsule or at least the synovia's as well as the fibrous cartilage He has met with secondary dislocations and loose joints only in some of his first knee cases The initia gain in motion is preserved or even increased with use He had trouble with persistent swelling especially in cases where this had existed for a considerable time before operation or had been marked He believes convalescence is shortened by waiting until the swelling has subsided If re-operation is needed he advises waiting at least six months In 1914 his first case was four years old He reports twenty two arthroplasties of which three were elbows one with a good result and two with very good results He believes that if the indications are correct and the technique and after treatment good a favorable result is to be expected in seventy to eighty per cent of the operations

Pupovac (75) reported a case of a girl of nine een whose elbow had become ankylosed at 130° as the result of a severe arthritis He did an arthroplasty using a posterior incision and a free fascial flap and gained motion from 105 to 140° Five months later he reopenend the joint and removed some exuberant bone that united the humerus with the ulna He gained 70° to 130° motion

Davis (41) thinks that we should be conservative about opening a joint ankylosed by tuberculosis He finds the elbow one of the most satisfactory joints for an arthroplasty as well as for an excision but the results with the former are much more satisfactory An excision requires the removal of 1 to 1 1/2 of bone to ensure movement but with an arthroplasty only sufficient bone need be removed to interpose the flap and it is almost certain to give a stable joint He used two pedunculated flaps one from either side The joint he believes should have drainage

Murphy (36a) reported in 1915 a case of ankylosis following fracture The elbow was ankylosed at about 150° with a few

pronation was somewhat fettered and supination was restored

Plummer (86) reported two arthroplasties in which he used pedunculated fat and fascia flaps One of his cases became infected and subsequently a portion of the end of the humerus had to be removed The resulting joint was somewhat flail but gave good function His second case also had good motion but his facility for moving the joint was not very good

Ryerson (87) gives in detail his operative technique in arthroplasty on the elbow joint He uses a long posterior incision avoiding the olecraanon The triceps tendon is cut and a thin shell of bone is removed from the external condyle taking the origin of the extensor with it Then a shell from the internal condyle is removed The joint is dislocated After it is remodeled a flap of fascia lata is interposed

Thomson (150) reports the end results in an elbow arthroplasty by the Murphy method Ankylosis was the result of sepsis following a fracture Seven months later elbow motion was good but somewhat restricted His successful cases have all been traumatic He believes that neisserian infection is a contra indication to arthroplasty as it stimulates bone formation Tuberculosis is also a contra indication on account of the recrudescence of the disease

A brief mention is made by Dr Prando (88) of a case using a modification of the Murphy method He did not use an Esmarch bandage and enveloped the ulnar nerve in a flap of muscle taken from the triceps He is satisfied with his results He also reports a case in which Dr Padman followed the Murphy method Satisfactory motion was obtained but later the joint re ankylosed Dr Prando believes the Murphy method is very good although it cannot be so successful as orthopedic resection on account of the great danger which the slightest negligence involves

Ceccarelli (89) used strips of fascia lata in an arthroplasty on a post traumatic ankylosed elbow The end result was perfect flexion extension to 165 and almost normal pronation and supination

Olivieri (90) reports two arthroplasties with interposition of strips of brachialis anticus The end results were perfect

that in an ankylosis following tuberculosis a free fascial trans plant is essential to success as the tissues about the joint are atrophied His case showed a perfect end result with normal flexion and 165° extension

Brown (121) gained 80° to 150 motion in an arthroplasty by the Murphy method The arm had been ankylosed in extension following acute metastatic arthritis

Rovsing (83) reported before the Northern Surgical Society two successful cases in which the Murphy method was used The ankylosis was the result of fracture In the discussion Bergman and Haglund expressed the opinion that mobilization of the knee should not be attempted

Moszkowicz (84) in his report in 1916 on his operations on war injuries to joints gives among other cases six elbow arthroplasties In all of these a useful degree of motion was gained

Ringel (153) in 1916 mobilized five cases of complete ankylosis of the elbow and implanted fat and fascia flaps One good result was obtained three cases were being treated when he reported and in the other case suppuration developed

Four cases of mobilization of the elbow in which flaps of fat were interposed were reported by Werde (167) in 1916 He obtained normal motion in all cases

Steindler (46) in 1916 reported two operations In one of ankylosis of the humerus a pedunculated muscle flap was used Mobility was good as long as the patient was under observation The end result is not reported The other case followed fracture of the head of the radius resulting in partial ankylosis A pedunculated fascia flap was inserted In two weeks range of motion was about normal

Crosti (85) in 1916 presented a case in which he had interposed an aponeurosis flap taken posteriorly from the forearm Complete bony union at an angle of 130° was a result of fracture from a shell There was a vast amount of cicatrix The olecranon was temporarily detached according to Durante s process To insure pronation and supination he interposed a small muscular flap between the radius and ulna according to the process of Huguier The olecranon was nailed in place Movements were started in ten days In eight months there was complete active extension flexion at an angle of 40° good movement

transverse incision across the arm above the olecranon The ulnar nerve was dissected the triceps muscle divided and the humerus exposed Flexion of 30° beyond a right angle and extension of 45° from a right angle were secured The pronation and supination amounted to about 30 due perhaps to too little excision of bone

Kerr (93) cited a case of complete ankylosis of the elbow following arthritis He used Kocher s incision and inserted periarticular fascia The result was a movable useful joint with no atrophy of the muscles

Verral (95) in 1920 described his method of operation He makes an 8 incision along back of the elbow The triceps tendon is divided in two layers to overlap when sutured A fascia flap is sutured over the end of the humerus The elbow is put at about 120°

Rocher (156) in 1920 applied Putti s technique using a flap of aponeurosis fascia lata in operating for a case of fibrous ankylosis of the elbow in an almost rectilinear position He secured a perfect functional result of voluntary flexion to 80° and pronation of 45°

Silverskiold (162) in 1922 reported an arthroplasty using flap of fascia lata In eight months the patient showed full active capacity for flexion and extension

Campbell (106b) has just published his method for arthroplasty of the elbow which is evolved from his method for reduction of old dislocations An incision 6 to 8 long is made on the posterior aspect of the arm and forearm The skin and fascia are incised and the deep fascia dissected laterally about 1 The suture is then dissected downward making a long tongue flap Through a further incision the periosteum is stripped from the lower third of the humerus A half inch of bone is removed from the humerus and the end modeled into a surface convex from before backward A half inch of bone is then removed from the tip of the olecranon process The surface of the head of the radius is made the same level as the coronoid process The periosteum and triceps are dissected into a double flap which is stitched to the anterior capsule One case of ankylosis as a result of acute infectious arthritis operated on by the above method in six months resulted in complete extension

Hohmann (94), in 1916 reported five elbow arthroplasties in which he inserted part of the triceps with good immediate results Lange at the same time showed six cases in which useful joints were obtained and the patients were enabled to resume their old occupations He used fat or muscle flaps

Baer (38a) in 1918 reported having done to date three arthro plasties on the elbow joint In one re ankylosis occurred one patient died and the third showed 25 motion He believes that the elbow is the least favorable joint for arthroplasty and that the success from the interposition of muscle or fascial flaps is due to the amount of bone removed rather than to the flap itself and that these operations are in fact only excisions In the discussion of this paper Galloway and Freiberg express the opinion that an arthroplasty has no advantage over an excision Davis states that with an arthroplasty a more stable joint is obtained

Albee (91) uses a vertical incision directly over the olecranon After retracting the ulnar nerve and dissecting the soft tissues he saws through the olecranon from within outward He remodels the joint and interposes a flap of fascia lata containing as much fatty tissue as possible The arm is put in plaster at right angles After ten days passive motion is begun

Henderson (92) in 1918 tabulated the end results of the forty three arthroplasties done at the Mayo clinic Twenty one of these were on the elbow He found the prognosis most favora ble in the jaw and next in the elbow The knee was the most unfavorable position In reports from other surgeons he found a general agreement as to prognosis

Kleinschmidt (142) in 1919 demonstrated two cases in which he secured mobility using Payr s method One case of complete ankylosis had resulted from a shot wound and the other from acute rheumatism Good active and passive motion to a sharp angle was secured the extension was complete and pronation and supination amounted to 60°

Grange (182) in 1920 used a flap of fat from the posterior surface of the triceps and a piece of cargile membrane on each side of the flap in an arthroplasty for complete ankylosis of the elbow at an angle of 90° The joint was reached through an incision 4 long on the outer and inner side of the joint and a

frequently possible to break open the old joint In some cases however ankylosis is bony and the joint cavity obliterated Cases of this kind are the most difficult It is in these cases necessary to saw through the joint The tip of the olecranon has to be chiseled out and dissected back with its posterior flap Usually the olecranon is too large and it is well to take off a little of it

The capsule fascia and ligaments are then dissected back so as to allow the lower end of the humerus to protrude into the wound Then its edges are snipped off with rongeur forceps and a new trochlear or intercondylar surface formed A shoe maker s rasp is used in filing the extremity as near like the normal humeral end as possible After this modeling a piece is removed corresponding to the olecranon fossa in the normal humerus One has to be careful about making this cup as the success of the operation depends largely upon attention to such small details This modeling is largely done with a saw and a file

To ensure good function the joint surfaces should fit accurately before the fascia is applied but the joint should not be too loose Only sufficient bone must be removed to give free motion If too much of the ends of the bones is removed a flail joint will result giving the operation no advantage over an excision When this mortising is completed the fascial flap is dissected from the leg (Fig 8) An incision is made on the outer side of the thigh a little below the middle extending down to the fascia lata After a flap of fascia 5 to 7 long by 4 to 5 wide is dissected out the wound is closed

This fascia which is free from all fat is placed about the newly fashioned humeral condyles and attached anteriorly to the capsule (Fig 9) and posteriorly to the periosteum of the lower end of the shaft of the humerus with interrupted chromic catgut sutures N° 2 Chromic catgut N 2 is then loosely wound twice around the shaft just below the interrupted suture line

The forearm is placed in apposition to the condyles Two drill holes are then made in the olecranon process and two others opposite them in the shaft of the ulna Through these kan garoo tendon is passed and tied The inner layer is now sutured with chromic catgut N 2 Dry sterile dressings are applied and the arm put up in plaster beyond a right angle

with flexion to 60° Physiotherapy is being used to increase the flexion

In case of a normal radio humeral joint with bony ankylosis between the humerus and ulna a hemi arthroplasty is done between the ulna and humerus and a broad aponeurotic tongue flap from the triceps interposed The one case reported of solid bony ankylosis in six months resulted in 50 % of the normal motion

The after treatment is very important and active motion is essential

OPERATIVE TECHNIQUE WRITER'S METHOD

The arm from the wrist to the shoulder and the leg on the same side from the hip to the knee are given a two day preparation At the time of the operation a tourniquet is applied to the upper third of the arm and an application of iodine made to the skin

A semicircular incision is then made beginning over the external condyle (Fig 1) running down about two inches and up over the internal condyle The wound is sponged with alcohol and carefully clamped off to avoid handling the skin during the operation The flap containing skin and superficial fascia is then dissected back to the base line and retracted The ulnar nerve is isolated and dissected out of its sheath (Fig 2) It is sometimes difficult to find this nerve but it is always to be sought at the inner side of the internal condyle It should be dissected out carefully with a blunt dissector so as not to break or injure it After it has been freed for 1 1/2 gauze is passed beneath the nerve and it is retraced to the ulnar side It is then freed further by blunt dissection with gauze

A transverse incision is then made extending down through the periosteum (Fig 3) This incision follows in direction the superficial one and outlines a flap which is to be dissected back and preserved *in toto* for subsequent covering for the joint The pulling back of this flap is a hard and tedious process until it is well started after which it can be pee'ed back readily by blunt dissection If is the inner side that is the hard part as the layer is thin here and one must exercise great care not to buttonhole it The olecranon is then sawed through After this it is

Aug 27 1913 the cast was split for dressing

September 1 1913 the wound had healed by first intention except for a slight discharge on the upper border

September 4 1913 daily manipulation of the elbow was ordered

September 10 1913 the arm could be extended completely and flexed to 15° beyond a right angle

September 15 1913 traction was applied for flexing and extending the arm

October 1 1913 active motion was possible

October 15 1913 I manipulated the arm under ethyl chloiid

May 15 1919, five years and ten months after operation she writes « the arm is doing excellent work » Photographs taken at this time show practically full extension and flexion (Figs 14 and 15)

Case II E S sustained a fracture of the right elbow on October 4 1913 as the result of a fall of forty two feet The roentgenogram showed a transverse fracture of both condyles with the radial head dislocated laterally and anteriorly

Physical examination was negative except for the righ arm The shoulder appeared normal The elbow was held at 150° extension with less than 3 motion Supination was limited one fourth The wrist showed a Colles fracture unreduced Flexion and extension were both one half normal Eversion was limited three fourths and inversion four fifths (Fig 16)

On March 25 1914 I did an arthroplasty on the right elbow, using a flap of fascia from the thigh When the joint cavity was opened it was found that the synovial tissue was hypertrophied and there was much fibrous callus formation infiltrating the articular surfaces A transverse fracture of both condyles was noted The head of the radius was impacted and was surrounded by callus formation

Five eighths of an inch of the condyles was sawed off square at right angles to the shaft of the humerus The joint surfaces were smoothed off and the operation completed according to mu usual method The arm was put up in plaster in an extended position The patient made a good ether recovery but suffered considerably from pain for which morphia was ordered

AFTER TREATMENT

If there is no evidence of infection the cast should remain on for a week It is then split and the dressing changed If there is a persistent temperature a window should be cut in the cast and the wound inspected

Passive motions are begun in about ten days if normal healing has taken place The arm is always kept above a right angle After three weeks gentle massage is applied Baking is begun in six weeks three or four times a week

The ultimate success in these cases depends very largely on the after treatment The patients should be under observation for a long period of time Frequent X Rays should be taken so that we may follow the bony changes in the joint If motion begins to shut down the arm should be manipulated under an anaesthetic and the elbow put up in acute flexion Occasionally motion becomes limited due to an exuberant growth of new bone In this case a secondary operation should be done to remove this but it should not be undertaken for at least three months after the original operation

Case I E S was admitted to the Carney Hospital August 11 1913 for immobility of the right elbow and right knee Six years previously the patient had had an acute illness accompanied by fever and pain and swelling in the joints for which she was treated in her home without relief At the end of eight months the pain and swellings had disappeared from her left shoulder and elbow so that she was able to feed herself but she remained in bed for twelve months and after this was in a wheel chair for two years The symptoms continued to subside and the pain and swelling disappeared fairly good motion returned to all the joints except the right elbow and the right knee in which pain and stiffness continued at the end of the fourth year and no motion was possible This condition continued up to the time of admission

August 14 1913 roentgenoscopy revealed an ankylosis of the elbow joint and of the patella to the femur (Fig 13)

August 20 1913 I did an arthroplasty of the right elbow using a flap of fascia lata A light plaster cast was applied Following the operation the patient made a good ether recovery There was slight pain in the elbow

After the operation the patient suffered considerably and showed some swelling of the arm On the fourth day the cast was split and the patient experienced relief

On the seventh the patient was comfortable and out of bed The following day he was discharged to report to my office

The end result shows nearly normal range of motion with a stable useful joint

On October 29 1920 he writes « I can crank a Ford I can do anything that I evercould My work is driving and repairing automobiles and I have had to change 387 tires on the road which requires the use of two good arms » (Fig 17)

Case III F D In 1910 the right elbow became swollen and tender At this time an open operation was done on the joint Six months later another operation was done after which the elbow drained for four years and the patient lost the entire use of the arm There were numerous scars above and about the elbow The elbow was ankylosed at 180 Finger and shoulder motions were normal

On August 10 1918 by my usual method I did an arthroplasty on his elbow He made a good recovery and had a normal convalescence Two weeks later he was discharged to have daily dressings done by the family doctor Motion at this time was from 80° to 100° without pain

He reported at my office on August 30 1910 At this time the wound was quite healed The elbow showed 30° motion He was then seen about every six weeks On October 18 1910 the wound was found healed Motion gradually increased

On December 9 1919 he showed motion from 35 to 145 with full supination The elbow was stable with no lateral motion He has no pain works as a telegraph operator and « lifts anything » (Figs 18 and 19)

For a full report of elbow arthroplasty the reader is referred to the author s (81) articles appearing in

a) Clinics of North America 2 959 972 Aug 1922

b) J Am M Assoc Chicago 1915 LXIV 312

c) Surg Gyn et Obst Sept 1921 223

and the following day the arm was put up in suspension He continued to suffer considerable pain for four days after which it abated

On March 29 1914 the wound was dressed and was found clean except for some serous discharge

March 30 1914 the cast was split and a voluminous dressing applied with splints to the forearm

March 31 1914 the patient was seen in consultation by Dr Courtney who reported a tourniquet paralysis and advised electricity and massage

April 1 1914 the wound was dressed and found clean and healing by second intention Electricity and massage daily

April 5 1914 the patient was out of bed and walking about the ward When dressed the wound was found clean

April 10 1914 the wound was dressed The motion in the elbow was good with supination and about 45 motion in flexion A nerve report was ordered

April 15 1914 the nerves were reported responding to the faradic current The prognosis was considered good Massage was advised

April 18 1914 the patient was discharged from the hospital to report daily at my office

November 30 1914 the patient re-entered the hospital for operative interference in an attempt to gain increased motion Both bones of the forearm had dislocated backward and the head of the radius was very much enlarged Motion was from 150° extension to 50° flexion with the carrying angle markedly increased

On December 2 1914 after the usual preparation a 4 incision was made over the external condyle The removal of the enlarged head of the radius caused a marked increase in motion but the posterior dislocation was not improved The internal condyle was chiseled loose and removed through a small incision over the fragment After the end of the humerus was smoothed as much as possible with a rasp the wound was closed and a cast applied with the arm at right angles A good ether recovery followed

the leg just above the mid horizontal line a distance of 5 to 10 from the joint proper (Fig 22) As much fat as possible is taken with this incision After clamping the skin edges with towels the skin is dissected to the inner side of the leg exposing the patella tendon patella and tibial tubercle

A curved incision is then made through the fascia beginning in the mid anterior line, about 5 above the patella and running between the patella and outer condyle to just below the knee joint

The quadriceps tendon is then exposed and elongated This elongation not only allows better joint exposure but affords a proper lengthening when we later place the leg in flexion in plaster This lengthening may a'so be done by the Bennett method (Fig 23) The patella is then raised from the femur taking the lower cut portion of the quadriceps tendon and forcibly retracted to the inner side of the knee with its inner ligament attachments intact Some surgeons detach a piece of the tibial tubercle in crder to increase exposure but I have found this unnecessary when the quadriceps tendon is elongated in the beginning There are also many difficulties when this piece is removed such as delayed or faulty union which complicatet he convalescence (Fig 24)

The patella in these cases is often found hypertrophied and should be narrowed laterally as well as thinned and smoothed with shoemaker s rasp

The joint being then exposed a careful study of it is made from X Rays and great care is taken to folaow the contour carefully Putti instruments are admirable for this purpose (Fig 25)

Several important requirements must be observed

1 Be sure to leave a well defined spine between the tibia condyle as wel' as cupping out the upper tibia surface which will help stabilize lateral mobility (Fig 26)

2 Carefully round the condyle with a Putti instrument and a shoemaker s rasp making a concavity to fit over the newly formed spine

3 Actually replace these opposing surfaces and mould carefu'ly without any irregular hitches during attempts to flex

KNEE

The knee joint presents a greater barrier to good arthroplastic work than any of the other large joints Lateral stability and security in the knee must be almost absolute Without stability a brace is necessary to permit walking even the use of a brace will not prevent the progress of overgrowth of bone (a direct result of undue strain) with its accompanying pain and soreness A stiff knee on the other hand is a good functional member if the ankylosis is firm and in good position (5° to 8 of flexion) (Figs 20 and 21)

If we consider arthroplastic measures in a single ankylosis of the knee they must be cautiously advised even in face of the advances that have been made largely by the splendid work of Professor V Putti of Bologna Athroplasty must be done with the assurance of stability and freedom from sensitiveness and pain In other words we must increase function in order to classify the result as good or improved

Progress is fast being made and although undoubtelly the last five years have seen a great advance in the number of functional results we expect better ones in the future

Generally speaking an ankylosis bony in character lends itself best to mobilization as it is more free from the results of tissue infection Such a condition is true of all joints

In general the results of fascia transplantation have proved most successful and the technique as advised by Putti has given the most consistent results I differ from his technique only in believing it advisable not to sever or disturb the patella tendon o its attachment

OPERATIVE TECHNIQUE AUTHOR'S METHOD,

The usual preparation is given both legs from the ankle to the groin I feel it is best to remove the fascia from the opposite leg thereby minimizing the extent of the operation on the ankylosed leg as well as making it possible to remove more fascia without disturbing the external support of the joint

The incision is made from just below the inner attachment of he patella tendon curving slowly over this point to the middle of the external cartilage and then directly up the outer side of

the leg just above the mid horizontal line a distance of 5 to 10 from the joint proper (Fig 22) As much fat as possible is taken with this incision After clamping the skin-edges with towels the skin is dissected to the inner side of the leg exposing the patella tendon patella and tibial tubercle

A curved incision is then made through the fascia beginning in the mid anterior line about 5 above the patella and running between the patella and outer condyle to just below the knee joint

The quadriceps tendon is then exposed and elongated This elongation not only allows better joint exposure but affords a proper lengthening when we later place the leg in flexion in plaster This lengthening may a'so be done by the Bennett method (Fig 23) The patella is then raised from the femur taking the lower cut portion of the quadriceps tendon and forcibly retracted to the inner side of the knee with its inner ligament attachments intact Some surgeons detach a piece of the tibial tubercle in crder to increase exposure but I have found this unnecessary when the quadriceps tendon is elongated in the beginning There are also many difficulties when this piece is removed such as delayed or faulty union which complicatet he convalescence (Fig 24)

The patella in these cases is often found hypertrophied and should be narrowed laterally as well as thinned and smoothed with shoemaker s rasp

The joint being then exposed a careful study of it is made from X Rays and great care is taken to folaow the contour carefully Putti instruments are admirable for this purpose (Fig 25)

Several important requirements must be observed

1 Be sure to leave a well defined spine between the tibia condyle as wel' as cupping out the upper tibia surface which will help stabilize lateral mobility (Fig 26)

2 Carefully round the condyle with a Putti instrument and a shoemaker s rasp making a concavity to fit over the newly formed spine

3 Actually replace these opposing surfaces and mould carefu'ly without any irregular hitches during attempts to flex

KNEE

The knee joint presents a greater barrier to good arthroplastic work than any of the other large joints Lateral stability and security in the knee must be almost absolute Without stability a brace is necessary to permit walking even the use of a brace will not prevent the progress of overgrowth of bone (a direct result of undue strain) with its accompanying pain and soreness A stiff knee on the other hand is a good functional member if the ankylosis is firm and in good position (5 to 8 of flexion) (Figs 20 and 21)

If we consider arthroplastic measures in a single ankylosis of the knee they must be cautiously advised even in face of the advances that have been made largely by the splendid work of Professor V Putti of Bologna Athroplasty must be done with the assurance of stability and freedom from sensitiveness and pain In other words we must increase function in order to classify the result as good or improved

Progress is fast being made and although undoubtelly the last five years have seen a great advance in the number of functional results we expect better ones in the future

Generally speaking an ankylosis bony in character lends itself best to mobilization as it is more free from the results of tissue infection Such a condition is true of all joints

In general the results of fascia transplantation have proved most successful and the technique as advised by Putti has given the most consistent results I differ from his technique only in believing it advisable not to sever or disturb the patella tendon or its attachment

OPERATIVE TECHNIQUE AUTHOR'S METHOD

The usual preparation is given both legs from the ankle to the groin I feel it is best to remove the fascia from the opposite leg thereby minimizing the extent of the operation on the ankylosed leg as well as making it possible to remove more fascia without disturbing the external support of the joint

The incision is made from just below the inner attachment of the patella tendon curving slowly over this point to the middle of the external cartilage and then directly up the outer side of

the leg just above the mid horizontal line a distance of 5 to 10 from the joint proper (Fig 22) As much fat as possible is taken with this incision After clamping the skin-edges with towels the skin is dissected to the inner side of the leg exposing the patella tendon patella and tibial tubercle

A curved incision is then made through the fascia beginning in the mid anterior line about 5 above the patella and running between the patella and outer condyle to just below the knee joint

The quadriceps tendon is then exposed and elongated This elongation not only allows better joint exposure but affords a proper lengthening when we later place the leg in flexion in plaster This lengthening may a'so be done by the Bennett method (Fig 23) The patella is then raised from the femur taking the lower cut portion of the quadriceps tendon and forcibly retracted to the inner side of the knee with its inner ligament attachments intact Some surgeons detach a piece of the tibial tubercle in crder to increase exposure but I have found this unnecessary when the quadriceps tendon is elongated in the beginning There are also manv difficulties when this piece is removed such as delayed or faulty union which complicatet he convalescence (Fig 24)

The patella in these cases is often found hypertrophied and should be narrowed laterally as well as thinned and smoothed with shoemaker s rasp

The joint being then exposed a careful study of it is made from X Rays and great care is taken to folaow the contour carefully Putti instruments are admirable for this purpose (Fig 25)

Several important requirements must be observed

1 Be sure to leave a well defined spine between the tibia condyle as wel' as cupping out the upper tibia surface which will help stabilize lateral mobility (Fig 26)

2 Carefully round the condyle with a Putti instrument and a shoemaker s rasp making a concavity to fit over the newly formed spine

3 Actually replace these opposing surfaces and mould carefu'ly without any irregular hitches during attempts to flex

4 Cup out a space into which the patella will articulate Great care should be taken with this modeling (Fig 27)

5 Remove a large piece of fascia lata ample enough to cover both condyles The fascia nearest the knee on the outer side is thickest and most serviceable When this is removed sew the fascia over the condyle covering all exposed bone well Sew posteriorly two inches above the articular surface (Figs 28 and 29) The femur is then adjusted to the tibia and the patella is replaced The outer fascia is united with interrupted chromic catgut

The elongated quadriceps is then strongly sutured and the skin closed with interrupted catgut (Fig 30) A plaster is applied from the toe to the groin with the knee in 35° to 40° flexion and the leg placed in an elevated position in bed Opiates are often necessary and may be freely used

AFTER TREATMENT

The temperature pulse and pain are carefully watched for any signs of infection

The cast is split for dressing in two weeks and the leg placed into a ring caliper with 35 flexion so arranged that this can be changed and passive motion slowly started

Traction is also applied with this caliper which remains on day and night

Gentle passive motions are started and increased gently guided by pain and sensitiveness which always should be minimized

Massage is started in five to six weeks for thigh and calf and the patient may usually walk with crutches about the sixth week

By means of an overhead extension the patient may also use passive motions in bed two or three times a day

Active motions are started or attempted about the tenth week preferably with the leg submerged in a tub of water No actual weight bearing is allowed until the lateral ligaments have tightened and a caliper may be applied to assist weight bearing depending wholly upon the sensitiveness and pain on use

Case I F O K Age 31 years

In 1909 patient had an acute neisserian infection in the left knee The opening of the joint resulted in an ankylosis The knee was in good position but there was no motion between the tibia and femur The patella was ankylosed to the femur Manipulations were unsuccessful in obtaining motion Arthroplasty was advised

December 14 1910 arthroplasty on left knee according to the technique as described on page 35

December 23 1910 out of bed Daily dressings

January 5 1911 cast removed Posterior shell applied

January 7 1911 small amount of weight bearing Crutches

January 19 1911 patient discharged from hospital In a leather leglet with limited motion To continue stretching and daily hot fomentations

January 3 1923 now twelve years since arthroplasty No pain and has had no trouble « No bother at all and can do everything Sometimes has to stop and think which is the operated knee » Has gained forty to fifty pounds Leg straight Good power in quadriceps Complete extension possible and 95° motion in flexion Absolutely no lateral mobility (Figs 31 32 33 34 35)

The use of the muscle flap from the vastus internus in operations of the knee joint was suggested by Helferich (21b) Cramer (96) followed his proposal and in 1901 reported ten operations of ankylosis of the patella by interposition of a piece of the vastus internus Six of these were successful Hoffa (24) reports eight tibiofemoral cases of his own He used fatty flaps One case resulted in 15° motion and ability to walk, the second in 15 and painful motion and the third in good motion but with slight limping In three cases ankylosis recurred The seventh case had good walking ability and the eighth had 15° motion seven months after the operation One patella case had 10° motion twoy ears after the operation Hoffa believes his results are due to shortening and the contraction and atrophy of the extensor muscles It is his opinion that the tendon should be lengthened by plastic operation or the tuberosity chiseled and attached higher up

Murphy (36a) first used his fascia method in 1901 on the knee joint A large layer of fascia lata with a thin layer of muscle attached was dissected from the outer surface of the vastus externus with its base below and anterior A small f ap of fascia covering the vastus internus was dissected free and placed between the patella and the femur Between 1912 and 1916 Murphy reported fourteen operations While at first he used fascia lata from the vastus externus he later used two implants of fat and fascia one lifted from the inner and one from the two aspect of the knee He also changed his incision from two vertical cuts to a U incision The patella was treated in four different ways by placing a flap under it by turning it turtle by rotating or by transplanting a detached flap of the trochan ter Of the fourteen cases there were two splendid results six good weight bearing legs one showed good flexion and extension improving and three records are incomplete In one a sheet of paraffin was inserted beneath the patella

Since 1901 many attempts to mobilize the knee using Baer s membrane cargile membrane free and pedunculated flaps of fascia have been reported

Mc Curdy (98) and Osgood (59) used Baer s membrane The former did not report on his result but Osgood found that although good or fair motion resulted there was some lateral motion These results I feel clearly show the loss of stability so dangerous to function and do not represent arthroplastic but rather flail joints

Tubby (79a) in 1914 interposed cargile membrane in three cases with one good result In the other cases the patients refused the after treatment

Schmerz (159) has had good results in the interposition of amnion membrane which he claims surpasses the fascia trans plantation in simplicity and safety

Whitacre (126) Neff (40) Owen (76) Quigley (131) Tubby (79a) Pringle (99) Mc Kenna (100) Thomson (150) Wheeler (168) Hohlbaum (139) Zeller (171) and Finochietto (102) have used pedunculated flaps of fascia In general good servicea ble knees were secured in two cases there occurred lateral mo tion and one case re ankylosed Of eighty five cases on which Hohlbaum (139) reported using free and pedunculated flaps there were 78 % good results and 22 % poor

Steindler (46) Thomson (150) Brandstrup (101) Hessert (103) and Goddu (104) reported the use of free fascia flaps with good results

Whitacre (126) Appel (128) Ogilvy (105) and Horhammer (138) secured good motion by the interpostion of fascia and fat flaps

Kirschner (130) and Osgood (59) followed Payr s method using free fascia flaps but in Kirschner s cases adhesions formed and Osgood s result was only fair and necessitated the wearing of a splint Simon (166) and Schloffer (158) however secured good results by the same process Tavernier (197) and Leriche (146) followed Putti s method The former secured good motion but Leriche s result was an unserviceable leg

Flaps of tissue were tried by Hoke and Andrews (97) without success Hofmann (5b) by the use of free periosteal flaps obtained only an active motion of 15 Fascia lata and strips of subcutaneous tissue were used by Verral (95) Roeren (157) secured immediate good results with the interposition of flaps of fat but the development of lateral motion made necessary the application of an apparatus Cotton (189) secured a good result by the interposition of a muscle flap

Campbell (105a) based his report on twenty four knee joint cases In ten cases using fascia flap one resulted in 40 motion one 30° six re ankylosed and on one there has not been time to report He used Baer s membrane in nine cases in one he obtained practically perfect motion in one 70 of free motion in four the membrane extruded and in two of osteomyelitis good results could not expected Two cases in which free fascia from the thigh was inserted were failures In three operations in which prepatellar bursa were inserted one resulted in 15 flexion and voluntary extension the second in 20 flexion and voluntary extension it was too early to report on the third case Of twenty of the cases on which there has been sufficient time to record the end results thirteen had definite voluntary motion four did not obtain motion of sufficient value and three were not successful as dense low bone was involved

Campbell does not consider his work on the whole satisfactory He recommends operations for ankylosis of complete destruction of the articular surfaces and adjoining bone and

solid union of bony surfaces In cases of complete fibrous ankylosis irregular scattered bans or irregular fibrous union with areas of destruction operation is also advised

Up to 1917 Baer (39b) had reported twenty eight cases of arthroplasties on knee joints He obtained serviceable motion only in cases of fibrous ankylosis between femur and patella or femur and tibia of which there were seven cases four gave 75 40 50° and 55° of motion respectively and good function three were failures— active tuberculosis set up In five cases of bony ankylosis betwen patella and femur and fibrous ankylosis between tibiofemoral joint excellent results were obtained In sixteen cases of bony ankylosis between the patella and femur and femur and tibia 19 % secured motion 7 % had no ultimate motion 6 % had 20° 2 % had 30° and 1 % 45

In his early cases Baer made two lateral incisions one on each side of the patella chiseled the bones apart and modeled the ends of joint surfaces The first piece of membrane was carried through the opening on one side of the patella to the other side The second piece overlapped the first the joint was covered as far as the top of the subquadriceps bursa Baer later used the horseshoe incision

The writer believes that the general opinion is that lateral incisions do not give sufficient exposure to properly model the femur and tibia

In 1920 Putti (50f) reported on ten cases of knee arthroplasty The largest range of motion obtained was 100° the smallest 50° and the average 82 The average age was twenty two years Putti thinks arthroplasty of the knee should be executed more frequently and that the restoration of the knee joint can give the greatest satisfaction to the patient There is more than an aesthetic value obtained by these operations Putti uses the method set forth by Ollier of resecting the articulating surfaces interposing membrane and preserving all the periarticular structures particularly ligamentous (Figs 36 37 38 39 40) A modification of the Kcher incision is used the cut is prolonged below to round the tibial tubercle This allows rolling in the skin after the insertion of the patellar tendon has been removed with the tibial tubercle A piece of bone 4 by 3 cm and 1 cm deep is removed Solid union of this afterwards is very impor-

tant As there is sometimes difficulty in making this union this constitutes the weak point of Kocher s *incision* Putti also uses the procedure of plastic elongation my an incision in a Z form of the quadriceps *tendon to overcome strong contraction* of the extensor apparatus This incision gives good access to joint surfaces

The joint exposed the femur and tibia ends are shaped the spine of the tibia made sharp and the intercondyloid groove deepened The transverse diameter of the condyles is persery ed but the sagittal diameter is decreased In this way the loss of the crucial ligaments is compensated The ankylosis is freed by a chisel to the posterior side He uses manipulation to break up the bony lamellae smooths resected surfaces by files and removes any cicatricial mass He advises against using patella flaps as he found the patella nearly *always increases in* thickness The patella should never be completely removed The ligamentum patellae and tibial tubercle are nailed in place by a double headed nail which is usually removed in a month If necessary for flexion the quadriceps tendon is lengthened by the Z method

For fifteen days the whole leg is in a plaster gutter splint in semi flexion 4 to 5 kgm traction are applied After the removal of the stitches the knee is suspended to an overhead frame with strap and pulley The amount of exercise depends on the patient s strength ability to stand pain and the reaction *of the joint With the patient on the edge of the* bed the limb hangs out and flexion is obtained by gravity In a month massage faradism heat and mechanotherapy (Bonnet s appa ratus) are used Auto immobilization is essential In one and one half months a stiff leg brace is applied The patient should have good use of the limb in three months

Among his cases Putti (50 d) reported one of complete bony ankylosis of the knee at an angle of 140° Suppurative arthritis had caused wounds to be open five months and resulted in deep cicatrix There was bony ankylosis between the femur and the tibia and between the femur and patella and periar ticular ossification (Figs 41 and 42) He used his regular technique in operating prolonging Kocher s incision at the base to encircle the tibial protuberance One month after the

operation there was 40° motion no pain and complete extension In five months the patient could walk long distances had complete extension and flexion to 110 There was slight lateral movement In seven months the flexion was 85° and there was more lateral movement The leg was serviceable Fourteen months after the operation the patient returned to the hospital because of severe pain in the knee The joint was flexed in the position of semi flexion and could not be extended After traction and hot air applications the joint improved The patient walked again and twenty seven months after the first intervention he could flex his knee to an angle of 85 had a movable patella and no lateral mobility (Figs 43 44 45 46 47)

HIP

Ankylosis of the hip practically always is seen in the position of deformity that is flexion and adduction (Fig 48) The correction of this deformity results in a functional limb for working use (Fig 49) It has however a distinct disadvantage in sitting stooping going up and down stairs etc as well as somewhat interfering with the gait As the joint is rotary it lends itself to arthroplastic measures In single ankylosis interference must be decided upon with caution and judgment In double ankylosis the decision is easier

Any increase in motion in this joint improves the knee joint action and this together with the hypermobility of the lumbar spine distinctly increases function One must however remember that stability is very necessary and unfortunate results such as dislocation have followed arthroplasty of the hip where stability has not been obtained

Hoffa s (24) statistics in 1906 recorded three operations on the hip by Rochet and two by Nelaton using muscle interposition One of the five cases showed a mobility of 40° in one year the other a good function of 45 in eight months One case had good mobility at first but it diminished later The fourth case had good motion five years after the operation and the fifth case resulted in poor function nine months after intervention

Hoffa (24) reported one of his own cases using a flap of fatty

tissue Seventeen months after the operation the patient walked but active mobility was somewhat restricted

Stein (55) in 1907 in Bier s clinic, interposed a flap of the sartorius muscle in a case of double ankylosis of the hip In five months there was 30 % of normal flexion and extension and abduction of 10 % of normal

Ahrens (111) in 1908 used the gluteus maximus muscle The patient walked in eleven weeks

Meyer (149) in 1909 cited a case of using a flap of fatty tissue with a thin layer of muscle on a hip ankylosed from spondylitis The thigh was flexed on the pelvis at 150° After the operation the patient had passive motion to 60° extension to normal adduction 30 and abduction 45

Duran (107) in 1910 used membrane and obtained motion of 50 % of normal

Murphy (36b) found that the hip joint gave him the best results in arthroplasty He used three incisions the original one was U shaped beginning 1 1/2 above the trochanter and 1 behind it extending down 2 below and passing under and in front of it up to a point opposite the commencement Sometimes the skin was divided down at the lowest point of the U to form the large interposed flap The second incision was along the iliotrochanter line 1 below and in front of the trochanter and upward for about 5 in a straight line with the anterior superior spine of the ilium The third was a modification of the second in that the incision was curved and convexed backward behind the trochanter (Fig 50)

His next step was to free the trochanter by a chain saw and retract it upward with attached muscles (Figs 51 and 52)

The ankylosed head of the femur was severed from the ilium as near the anatomical line as possible with a carpenter s and cabinet curved chisel (Fig 53) It was drawn obliquely into the acetabular cavity for 1 The head was fractured out and a special globular burr fashioned the acetabular cavity A cup shaped well conformed the femoral head (Figs 54 55)

A flap of fat and fascia fascia lata and subcutaneous fatty tissue (1/4 thick) was inserted behind the head and neck of the femur and the edge was sutured to the acetabular margin and to the capsular ligament with phosphorbronze wire (Fig

operation there was 40 motion no pain and complete extension In five months the patient could walk long distances had complete extension and flexion to 110° There was slight lateral movement In seven months the flexion was 85 and there was more lateral movement The leg was serviceable Fourteen months after the operation the patient returned to the hospital because of severe pain in the knee The joint was flexed in the position of semi flexion and could not be extended After traction and hot air applications the joint improved The patient walked again and twenty-seven months after the first intervention he could flex his knee to an angle of 85 had a movable patella and no lateral mobility (Figs 43 44 45 46 47)

HIP

Ankylosis of the hip practically always is seen in the position of deformity that is flexion and adduction (Fig 48) The correction of this deformity results in a functional limb for working use (Fig 49) It has however a distinct disadvantage in sitting stooping going up and down stairs etc as well as somewhat interfering with the gait As the joint is rotary it lends itself to arthroplastic measures In single ankylosis interference must be decided upon with caution and judgment In double ankylosis the decision is easier

Any increase in motion in this joint improves the knee joint action and this together with the hypermobility of the lumbar spine distinctly increases function One must however remember that stability is very necessary and unfortunate results such as dislocation have followed arthroplasty of the hip where stability has not been obtained

Hoffa s (24) statistics in 1906 recorded three operations on the hip by Rochet and two by Nelaton using muscle interposition One of the five cases showed a mobility of 40 in one year the other a good function of 45 in eight months One case had good mobility at first but it diminished later The fourth case had good motion five years after the operation and the fifth case resulted in poor function nine months after intervention

Hoffa (24) reported one of his own cases using a flap of fatty

tissue Seventeen months after the operation the patient walked but active mobility was somewhat restricted

Stein (55) in 1907 in Bier s clinic interposed a flap of the sartorius muscle in a case of double ankylosis of the hip In five months there was 30 % of normal flexion and extension and abduction of 10 ° of normal

Ahrens (111) in 1908 used the gluteus maximus muscle The patient walked in eleven weeks

Meyer (149) in 1909 cited a case of using a flap of fatty tissue with a thin layer of muscle on a hip ankylosed from spondylitis The thigh was flexed on the pelvis at 150° After the operation the patient had passive motion to 60° extension to normal adduction 30 and abduction 45°

Duran (107) in 1910 used membrane and obtained motion of 50 °, of normal

Murphy (36b) found that the hip joint gave him the best results in arthroplasty He used three incisions the original one was U shaped beginning 1 1/2 above the trochanter and 1 behind it extending down 2 below and passing under and in front of it up to a point opposite the commencement Sometimes the skin was divided down at the lowest point of the U to form the large interposed flap The second incision was along the iliotrochanter line 1 below and in front of the trochanter and upward for about 5 in a straight line with the anterior superior spine of the ilium The third was a modification of the second in that the incision was curved and convexed backward behind the trochanter (Fig 50)

His next step was to free the trochanter by a chain saw and retract it upward with attached muscles (Figs 51 and 52)

The ankylosed head of the femur was severed from the ilium as near the anatomical line as possible with a carpenter s and cabinet curved chisel (Fig 53) It was drawn obliquely into the acetabular cavity for 1 The head was fractured out and a special globular burr fashioned the acetabular cavity A cup shaped well conformed the femoral head (Figs 54 55)

A flap of fat and fascia fascia lata and subcutaneous fatty tissue (1/4 thick) was inserted behind the head and neck of the femur and the edge was sutured to the acetabular margin and to the capsular ligament with phosphorbronze wire (Fig

operation there was 40° motion no pain and complete extension In five months the patient could walk long distances had complete extension and flexion to 110 There was slight lateral movement In seven months the flexion was 85 and there was more lateral movement The leg was serviceable Fourteen months after the operation the patient returned to the hospital because of severe pain in the knee The joint was flexed in the position of semi flexion and could not be extended After traction and hot air applications the joint improved The patient walked again and twenty seven months after the first intervention he could flex his knee to an angle of 85 had a movable patella and no lateral mobility (Figs 43 44 45 46 47)

HIP

Ankylosis of the hip practically always is seen in the position of deformity that is flexion and adduction (Fig 48) The correction of this deformity results in a functional limb for working use (Fig 49) It has however a distinct disadvantage in sitting stooping going up and down stairs etc as well as somewhat interfering with the gait As the joint is rotary it lends itself to arthroplastic measures In single ankylosis interference must be decided upon with caution and judgment In double ankylosis the decision is easier

Any increase in motion in this joint improves the knee joint action and this together with the hypermobility of the lumbar spine distinctly increases function One must however remember that stability is very necessary and unfortunate results such as dislocation have followed arthroplasty of the hip where stability has not been obtained

Hoffa s (24) statistics in 1906 recorded three operations on the hip by Rochet and two by Nelaton using muscle interposition One of the five cases showed a mobility of 40° in one year the other a good function of 45 in eight months One case had good mobility at first but it diminished later The fourth case had good motion five years after the operation and the fifth case resulted in poor function nine months after intervention

Hoffa (24) reported one of his own cases using a flap of fatty

use of the chromicized pig s bladder The resulting motion in nine cases of gonorrheal arthritis was active motion in 89 % Two cases operated on in 1909 resulted in 20° and 40° motion respectively Infection was the cause of failure in one case in the other the periarticular tissues needed stretching In twenty one cases of tubercular origin 66 % good voluntary motion utility and good walking ability were secured One hundred per cent good serviceab'e motion resulted in fifteen cases of infectious arthritis In five cases of arthritis deformans involv ing spine hip knees and ankles 60 % motion was obtained

Baer makes his incision from the anterior superior spine down the thigh parallel to the femur between the tensor femoris muscle on the outer side and the sartorius on the inner The capsule is stripped back the ends of the bones shaped and the membrane thrown around the femoral head

Baldwin (115) in 1915 reported a successful result using Baer s membrane

Neff (40) used a U incision with reflexion of the flap upward for the formation of a long broad flap of fascia lata If capsule was available, it was used for flaps if not fascia was interposed

In 1913 Osgood (59) reported on five cases in one using the capsule for a flap the result was poor in the second case using tissue flap the outcome was fair in the third casé of excision death resulted in the fourth case of fibrous ankylosis in which free fascia was used the result was good and in the fifth case of fibrous type involving a part excision according to Baer s method the result was fair and improving

Two methods are used by Payr (74b) on the hip One consists of the separating of the ankylosis smoothing off of the head of the bone or building a new rounded epiphysis out of the neck of the femur with interposition of fat (free or pedunculated) or a flap from the tractus ileo tibialis The second process is the formation of a pseudoarthrosis as near as possible to the aceta bular margin likewise with the interposition of soft parts Payr tries to form the pseudoarthrosis after the manner of a saddle joint stimulating the carpo metacarpal joint

Corner (55) Steindler (46) and Hallopeau (132) reported the use of fascia lata in the hip Corner and Steindler did not

56 57) The head was replaced The trochanter was nailed in place (Fig 58) The fascia was re approximated by chromic catgut and the skin sutured with silkworm or horsehair No drainage was used

The operated field was dusted with bismuth subiodide powder and the wound sealed with gauze saturated with collodion A pad of plain sterile gauze moistened with 95 % alcohol and 6 % phenol was placed over the hip four or five inches beyond the line of incision on either side A Rainey travais splint and Buck s extension with twenty to twenty five pounds were applied Both legs were dressed in an abducted position

Passive motion was instituted in three or four weeks

In the majority of cases of ankylosis of the hip reported by Murphy there resulted a good range of motion and ability to walk without support Among them was one case of metastatic origin of complete bony ankylosis of the left hip with rotation of the leg inward and adduction beyond the pelvic inlet (Fig 59) The usual technique was followed in the operation The patient made an excellent recovery In year she could walk without support and had full flexion (Figs 60 61 62)

Pettis (112) Torrey (113) Clark (114) Gibby reported by Mc Curdy (98) Ceballos (116) Prando (88) Thomson (150) and Burlew (117) reported cases in which they had followed the technique of Murphy using pedunculated flaps Several good results were recorded Thomson believes his case re ankylosed because he removed too little bone

Mc Kenna (100) outlined his technique as a modification of the Murphy goblet shaped incision The cut was carried farther back to secure a fat and fascia flap that comes directly under the gluteus muscle This fits into the acetabular cavity without cutting the pedicle of the flap

Perthes (186) in 1919 mobilized a hip joint ankylosed in the position of adduction After the freeing of the ankylosis two pedunculated fat and fascia flaps were interposed In spite of ankylosis of the other hip joint and of the two knees and of paralysis of the sciatic nerve walking was possible

Baer (38b) in 1917 reported his series of fifty cases of bony ankylosis of the hip in which an arthroplasty was done with the

A study of the junction between the head and the ilium is made and then with a curved chisel covering a small space at a time the femur is separated from the acetabulum Care should be taken to follow the outline of the acetabulum as this is always hard while the head is usually atrophied (Fig 66)

Finally the head is freed and dislocated With the Murphy male and female rasp (Fig 55) The acetabulum is thoroughly reamed out and the head is thoroughly rounded (Fig 67) Great care should be taken to remove all spicules of bone

A piece of free fascia lata from the outer side of the opposite leg is removed and sewed around the neck of the femur by interrupted sutures Then a purse string is tied about it tightly (Fig 68)

The head is reduced (Fig 69) The old capsule is returned and sewed together and to the old attachments as nearly as possible I feel that this very materially adds to stability and ensures against dislocation or a wabbly unstable joint

The trochanter is then pulled down to its old position and held by resuture of the periosteum with fascia originally elevated The skin is closed and the leg placed in plaster from the nipple line to the toe with the leg in 10° abduction complete extension and a little pressure over the trochanter

The cast remains on two and one half weeks and is then removed and traction applied Passive motions are started at the third week and should always be within the limits of pain The patient is encouraged to voluntarily contract the thigh muscles and thereby get voluntary control early

The patient may walk with crutches in six weeks and bear a little weight in about eight weeks Convalescence as regards motion varies with the type of individual but all motion should be within the pain limits

Case I O P Age 24 years Patient had an ankylosis of three years duration involving both hips and knees due to an infectious process probably neisserian in origin (Figs 70 71)

April 12 1920 Arthroplasty of right hip by Dr Andrew R Mac Ausland using the technique as outlined It was then

record their results but Hallopeau secured a good weight bearing leg after operation for double bony ankylosis of four year s standing

Grange (182) in 1920 reported three cases of arthroplasty In one of bony ankylosis with internal rotation of the thigh of traumatic origin a curved incision was made berween the crest of the ilium and the great trochanter the femur was divided at the neck and a flap of gluteus medius sutured over the raw end of the neck of the femur and a loose flap of fat from the buttock placed in the cup in the head of the femur Within two months the patient could flex his hip to a right angle

Hohlbaum (139) in 1921 reported twenty cases of hip anky losis of tubercular rheumatic gonorrheal arthritic and other origins Free fascia and pedunculated flaps were interposed There were six very good results five good results six cases re anky osed two patients died and one result was unknown

In operation on the hip I use the following technique

The patient is given a very careful two day preparation of the hip from the rib line to below the knee

A skin incision is made beginning at the anterior superior spine and running in a horizontal plane to about 2 below the level of the trochanter at which point it curves over the femur 3 to 4 below the trochanter in a U shaped fashion (Fig 63) This flap with considerable fatty tissue is elevated raised to its base line and retracted

A similar incision is made through the fascia external to the sartorius and sweeps around about 3 below the trochanter at which point it reaches the base of the femur The perios teum is separated downward 1/2 and then upward to the base of the trochanter (Fig 64)

With a 2 osteotome the entire trochanter is removed and elevated taking with it all the muscle attachments

An incision is then made through the capsule beginning on the ilium and passing parallel to and in the center of the femoral neck to the base of the detached trochanter (Fig 65) At the attachment of the capsule to the femoral neck it is cut off around on both sides for a distance of 1 1/2 and retracted A blunt dissector then frees the capsule from the neck as much as possible

in all of these cases and although the mortality is high in young children and the dangers of infection considerable, the relief is at times a matter of necessity The method as described by Murphy has been accepted as standard

An incision is made in front of the ear from 1/2 below the root of the zygoma up to the hair line The incision may be curved in convexed backward passing forward under the zygoma to 1 in front of the ear, 2 above the zygoma The L incision gives best access (Fig 82)

The ankylosis is divided and a flap of temporo maxillary muscle aponeurosis dropped over the zygoma (Fig 83 84 85 86 87)

Murphy (36b) in 1913 brought to our attention his series of nine arthroplasties of the jaw seven for bony ankylosis and two for extra articular fibrous fixation The first case of a boy with fibrous ankylosis of the left temporo mandibular joint and bony ankylosis of the right resulted in the ability to open his mouth 1 four weeks after the operation Now he can put an apple between his teeth An operation on a case of fibrous ankylosis allowed the opening of the jaws to 1 1/2, three months after the operation

Another patient who had fibrous ankylosis could open his mouth 1 in five weeks after the operation

As the impairment of health is involved in an ankylosed jaw early attempts at operation were made

Hoffa (24) collected eighteen cases Helferich one Lentz one Mikulicz one Heale one Bilczynski one Kusnetzow one Gluck two Rochet four Schmidt one Foderl one Orlow two Meyer one and Beresowski one In thirteen cases in which muscle flaps were used good results were secured and the average separation of the incisor teeth in ten cases was 2 6 cms Good results were obtained in two cases using skin flaps In one inserting hog s bladder the incisors were separated 2 6 cms and in two cases using gilded plates 2 and 1 75 cms

Hoffa (24) reported two of his own cases one of simple resection resulted in a separation of 2 cms and the other using a temporal muscle flap allowed the placing of two fingers between the jaws

ut three years since the original infection The operation was followed by some shock Perfect healing of the wound Cast applied

May 17 1920 Cast removed and passive movements encouraged

June 5 1920 Out of bed with crutches

June 10 1920 Walking with crutches

June 12 1920 Discharged from hospital

January 13 1923 No pain Motion in flexion 40°

Motion in adduction and abduction in arc of 15° to 20° (Figs 72 73 74 78 79 80 81)

Case II O P Age 24 years The previous history of this case was reported under Case I Both hips were ankylosed (Figs 69 70)

Nov 2 1920 Seven months after the operation on the right hip Dr Andrew R Mc Ausland did an arthroplasty of the left hip using the regular technique

Nov 29 1920 Cast removed Wound healed by first intention

Dec 6 1920 Passive motions started

Dec 17 1920 Patient up in wheel-chair Some sensitiveness Omit motion for one week

Dec 26 1920 Passive motion renewed

Jan 4 1921 Walking with crutches

Jan 22 1921 Discharged from hospital

Jan 12 1923 No pain Motion in flexion 40° Good abduction and addution Excellent functional result (Figs 75 76 77 78 79 80 81)

JAW

Ankylosis or greatly limited motion in the temporo maxillary articulations early assumes dangerous proportions owing to the inability to take nourishment In young children this condition is complicated by the dangers from swelling during throat infections so common in this type of case Much of this infection undoubtedly arises from the inability to give proper hygienic care to the mouth and teeth Arthroplasty is indicated

Putti (50a) in 1913 reported three jaw arthroplasties In operation he used Abbe's incision resected enough bone to allow opening the jaw and interposed a free flap of fascia lata 6 x 8 cm taken from the base of the great trochanter In the post operative treatment the passive exercices are regulated by means of wooden wedges

Four months after intervention in the first case of total bilateral ankylosis of blennorrheal origin the patient had nearly normal motion The after treatment had been neglected which accounted for loss of complete mobility In one month after operation in the second case of complete congenital ankylosis of the right temporal jaw the child could open his mouth to allow a space of 2 5 cms between the incisors The third case one of complete ankylosis between the condyle and glenoid on the left side showed in one year the ability to open the mouth fully

Blair (172) in 1914 found a flap of subcutaneous temporal fascia admirably adapted for interposition His incision was almost completely within the hair line Enough bone was removed to leave a space 1/2 wide The immediate result was 3/4 to 1 opening and this by the use of a rubber bottle stopper was increased further

Carr (120) in 1917 obtained three good results using a modification of the Murphy method He was unacquainted with the Murphy process at the time but he would use it on future cases In eighteen months one patient who had complete fixation for years could separate his teeth 1 1/4 The second patient in three weeks could open and close his mouth without discomfort and the third patient could eat in three days as the muscles had not been greatly contracted

The same year Prando (97) applied the Murphy method in a case Although it became gangrenous the case turned out well and the patient can open his mouth and talk clearly

Henderson and New (92) in 1918 tabulated twenty three cases of ankylosis of the lower jaw operated on in the Mayo clinic during a period of eight years They divided the ankylosis into articular extra articular and articular extra articular types depending on the location of the fixation Fifteen cases were articular five extra articular and the remainder articular extra

Biermann (119) in 1909 reported using a flap of the temporal muscle and obtaining a good result

Stein (55) in the same year obtained a perfect recovery of a case using muscle flaps

Baer (38b) in 1917 recorded his series of nine cases in which eleven operations on temporo maxillary jaws had been done One excellent result was secured in which a boy had even more motion than normal The other cases showed good results In case 8 the patient could open his mouth only 3 cms this case had been operated on twice by other methods and had been ankylosed twenty three years

An arthroplasty on another case of marked cicatricial changes allowed the opening of the mouth to the extent of 0 5 cm A baby eighteen months old and in weakened condition died from the effects of the operation

Baer in his technique first scrubs the place of operation using potassium permanganate oxide and bichloride of mercury ether and alcohol The incision is made parallel to the zygoma and along its lowest border the fibers of the external pterygoid muscle are separated and the temporal muscle retracted forward He then cuts through the periosteum of the ramus of the inferior maxillary bone and exposes the condyle This is separated from the ramus and the temporal bone The bones are shaped and a cuff of membrane sewed to the periosteum of the bone The muscle is brought together and sewed and the wound is closed After two weeks the patient is encouraged to use his mouth and movements are regulated by graduated corks

An arthroplasty using Baer s membrane was reported by Osgood (59) in 1911 for complete bony ankylosis of the jaws of two years duration A slight pus discharge made necessary an incision and the removal of the membrane Four months after the intervention the motion was good

Neff (40) used a curved incision beginning in front of the tragus and carried up over the zygoma Fascia was stripped from the zygoma subperiosteally The condyle was separated from the glenoid fossa and the joint mobilized A flap from the temporal fascia or masseter was sutured to the capsule on the inside

Chubb (177) in 1920 reported a method which he had found very successful He divided the operation for ankylosis of the jaw into two groups according as the bone is resected from the region of the condyle or from the horizontal ramus

The bony or fibrous ankylosis in the five cases he described was between the anterior border of the coronoid and the pterygoid aspect of the maxilla Four cases were traumatic One was infective in origin, and followed by a bilateral suppurative arthritis of the temporo mandibular joints in infancy

In operation, the incision started in the pre auricular fold at the lower level of the external auditory meatus passing vertically upward to the level of the tip of the pinna and curving forward below the superior temporal crest to terminate anteriorly within the hair region The zygoma was exposed and the necessary bone removed piecemeal The whole coronoid process was removed

In the case of infective origin of fifteen years standing the condylar neck region and coronoid of the left and right sides were resected The operation was completed by a flap of temporal fascia and muscle

The result in all cases was a gap of at least 2 5 cms and a very satisfactory power of mastication

Imbert L (136) in 1921 emphasized regulating the dimensions of the incisions for ankylosis of the jaw by the crossing of the facial nerve on the neck of the ondyle The upper extremity of the incision should be about 2 cms above the most prominent part of the tragus The resection of the condyle is made by means of scissors and is at least 0 5 cm in height He recommended the interposition of soft parts

Dufourmentel and Darcissa (196) in 1921 presented two cases In one of complete temporo maxillary ankylosis of gonococcic origin the thickness of bone was destroyed and a piece of rubber inserted Their special apparatus was used in the after treatment Three months after the operation the power and amplitude of the jaw was normal A second case using a muscular aponeurotic flap failed resection with no interposition of rubber resulted in a normal joint

Bockheimer (173) in 1922 used an incision behind the ear in freeing bony ankylosis of the jaw of inflammatory origin

articular The average age of the patients was under ten years Excision was the basic principle of each operation and no interposing substance was used

The fifteen cases did well and from 1 to 1 3/4 separation was obtained In the extra articular types the best results were secured by forcible stretching In the articular-extra articular type the scarring of the muscles prevented wide separation but all the patients secured an opening of an inch

Douglas (129) in 1919 operated for complete bony ankylosis of the left temporo maxillary joint A horizontal incision was made just above the zygoma the bones were separated and a flap of the temporal fascia with overlying fat interposed The final result was excellent although after treatment was not carried out

Woolsey (170) also did a similar operation and obtained a good result He kept the jaws apart for some time after the operation

Kerr (93) in 1920 cited four successful cases One patient could open his mouth 1/6 and the second 1/4 A curved L shaped incision was made beginning 2 above and 1/2 in front of the ear and down to the external auditory opening then anteriorly for 1 1/2 The facial nerve was avoided The condyle of the mandible was sawed off with a chain saw and a flap of temporal mu cle inserted Both patients can masticate normally The third patient suffering fibrous and bony anky losis of both joints of the mandible with contractions of the periarticular muscles and fascia after operation could masti cate solid food He had to guard against muscle contractions The fourth patient after operation could open her mouth nor mally and masticate food

Ritchie (154) in 1920 emphasized the importance of the after treatment in the form of continual motion during waking hours and wearing a rubber gag at night He reported two cases using flaps of temporal muscle In one case the flap was cut too short and pulled off when applied as a free flap It was extruded on the fifth day In the other case the flap was cut large enough The end results of both cases were equally complete

By tightening the muscle was applied in the articular cavity The result was good there was passive motion in three days The patient can sew Abduction is limited

Hofmann (5b) in 1908 used periosteal transplants from the tibia The results were excellent one year after the operation the rotary movments were almost normal There was active abduction with fixed scapula up to 45 after which the scapula moved with the arm

Ochsner (124) always conservative in advising arthroplasties in ankylosis with deformity makes a vertical incision over the midd e of the deltoid muscle and separates the fibers by the Kocher dissector A vertical incision is made in the capsule to expose the head of the humerus This is severed by cutting the neck with a chain saw Strands of silkworm gut are insert ed for drainage The arm is bandaged snugly to the side and the forearm placed in a sling He has not found it necessa ry to use a fascial flap All of his patients within a few months have been able to use the arm as before ankylosis they can comb their hair, etc

In the treatment of ankylosis without deformity, in the finger ankle shoulder joint or wrist Ochsner does not consider arthro plasty indicated In the knee e bow and hip the subject is debatable On the knee he uses the resection method on the hip subtrochanteric osteotomy and on the elbow force only He commends the Murphy method

Neff (40) believed that operation in the shoulder is rarely indi cated as the scapular muscles provide good function In case of intervention he advised reaching the joint through an incision 3 1/2 long extending from the base of the coracoid and on a level with it down on a line with the bicipital groove The cephalic vein serves as a guide The greater tuberosity is divided by means of a Gigli saw and retracted upward The remainder of the operation is like that on the hip Fascia or capsule may be used as flaps

Murphy (36e) did not report an arthroplasty of the shoulder but in 1913 he outlined his technique on the cadaver as follows The skin and deltoid are split and the fascia separated along the anterior margin for 4 It is then elevated to expose the coracoid process with the head of the biceps and coracobrachia

After resection a flap of fat and fascia was interposed In fifteen months the patient could open her mouth normally This incision had the advantage of avoiding the facial nerve and of hiding the scars

Gilpatrick (180) recently (1922) reported a severe case of ankylosis of the jaw very similar to a case reported by Murphy The patient had had almost complete ankylosis of the inferior maxilla for fourteen years as a result of scarlet fever complicated by an infection of both mastoids The food had to be macerated in the plate and the boy could talk only through clenched teeth

The right side was attacked first in operation An incision 1 1/2 long was made in front of the right ear from a point 1/2 below the zygoma upward All new bone was removed The jaw could then be opened so that the left side was not touched A flap of fat and fascia from the skin anterior to the original incision was interposed In ten days the patient could eat

SHOULDER

The shoulder joint is rarely the seat of troublesome ankylosis The mobility of the scapula replaces the lost motion especially when ankylosis has occurred in the position of election that is abduction of 50° to 70° and flexion of about 15° to 20° forward of the frontal plane in which position the shoulder function closely simulates normal (Figs 88 89)

No arthroplastic measure can be considered in the absence of the deltoid muscle

The first arthroplasty of the shoulder was reported by Nelaton (34) in 1903 The operation was done by Caville A 4 incision was made below the clavicle passing externally to the coracoid process down along the arm following the fibers of the deltoid The head of the humerus was divided at the level of the anatomic neck A piece of deltoid obtained by a transverse section was interposed between the surface of the humerus and the glenoid cavity A counter incision was made at the same level and a thread passed through the opening surrounding in loop form the extremity of the muscular strip

resulted in perfect motion The patient a carpenter resumed his trade in six weeks There was some restriction of the arc of motion because of periarticular contraction but two years after intervention the patient had practically recovered the arc of motion

Ringel (153) demonstrated a case in which there had been a complete shattering of the shoulder region treated by freeing of the joint and interposing a pedunculated muscle flap from the deltoid The immediate result was so good that the patient returned to the army Later it was found that the flap had sloughed and new bone formed In the second operation a broad fat and fascia flap from the thigh was fixed over the humerus Free motion in all directions was obtained the arc of motion was limited because of the great atrophy of the deltoid

Thomson (150) reported a case in 1917 He made an anterior incision removed the greater part of the head of the humerus and stitched in a piece of fascia lata from the thigh The limb was put in the position of right angle abduction A sufficient range movement was secured

Verrall (95) believes he was justified in operating on a shoulder adducted and having a small degree of painful motion as he did not jeopardize arthrodesis in a good position He exposed the joint along the anterior border of the deltoid and dislocated the humerus through the wound The glenoid was hollowed into shape and 3/4 of the humerus removed A flap of subcutaneous tissue from over the deltoid was turned over the glenoid He does not report his result

Grange (182) in 1920 did an arthroplasty for ankylosis of the shoulder joint in a slightly abducted position with a good deal of destruction of the head and great tuberosity In the operation an incision was made along the lower border of clavicle and down the front of the arm for three inches another was made just below the acromion process to meet the first and a third was made along the lower border of the pectoralis major This was divided where it crosses the axilla and the anterior half of the deltoid was cut through 1/2 below the acromion process and turned down The short head of the biceps and coracobrachialis were then divided The humerus was ex

lis The process is divided 3/4 from the tip and displaced outward The ankylosis is chiseled between the glenoid fossa and the head of the humerus and an additional excavation of the glenoid fossa made An incision at a right angle to the original incision is made across the chest over the middle pectoralis major muscle A flap of fat aponeurosis and pedunculated muscle is placed between the head of the humerus and the glenoid fossa The anterior portion of the deltoid may also be used as a flap

W L and C P Brown (82) in 1914 reported the use of a portion of the short head of the biceps for the interposed flap It is located correctly anatomically and covered with a tendinous sheath its attachment to the coracoid process gives the pedicle the right location An incision in the shape of a reversed «S» is made from the junction of the middle and outer thirds of the clavicle forward and downward below the acromion process The muscle fibers of the sulcus should be separated coming down directly on the tendinous attachment of the inner head of the biceps The tendon of the pectoralis major should be transfixed with a linen thread and then cut loose from the humerus the attachment of the inner fibers of the deltoid is transfixed and severed from the humerus which will facilitate its retraction The forefinger of the left hand is passed beneath the inner head of the biceps separating it from the coracobrachialis and then its sheath and fibers cut across 4 1/2 below its attachment at the glenoid cavity About one half the muscle of fan shape 4 1/2 x 3 1/2 is taken The capsule of the joint is opened and the head of the humerus is separated from the glenoid fossa preserving the head of the biceps if possible Enough capsule is removed to mobilize the joint The flap is drawn in place by three No 1 chromicized catgut sutures guided by the finger If the capsule allows good motion it should be sutured otherwise it should be free If the pectoralis major has contracted it should not be reattached to the humerus unless it is lengthened

The arm is put in a cast at right angles to the body with the forearm flexed if the head of the biceps is severed The cast is removed in ten days

The case of infectious origin on which the operation was done

The other case of bony ankylosis between the ulna and radius when chiseled apart gave 90 supination and pronation

L Duran (107) in 1910 did an arthroplasty using Baer s membrane Painless mobility of about 50 % of normal resulted in one month

Mention has been made of an arthroplasty by Whitman (60) in 1911 in which a section representing the first row of carpal bones was removed and the deformity corrected The record is incomplete

Neff (40) in 1912 outlined his technique of operation on the wrist A convex incision with the convexity downward through the skin on the dorsum of the wrist extending from the ulnar to the radial side division of the posterior annular ligament and retraction of the extensor tendons laterally division of the capsule transversely low down on the carpal bones and dissection of it upward leaving it attached to the radius and ulna resection of the first row of carpal bones in an arched direction with convexity upward inversion of the posterior capsular flap between the articular surfaces If there is not sufficient capsule a fascia lata flap or rectus aponeurosis may be used The wound is sutured and passive and active motion and massage begun on the eighth day

Murphy (36f) in 1913 reported three wrist arthroplasties In one of infection an incision was made over the end of the radius on the back of the arm and a flap of superficial fat and fascia interposed between the radius and the scaphoid Limited motion resulted ankylosis did not recur The second case was that of a woman who had mutiple arthritis of six years duration Elbows ankles knees and hips were involved On one wrist he made a longitudinal incision over the ulnar styloid process dissected down on the ulna and with an elevator separated the muscles tendons and arteries Care was taken not to dissect the periosteum from the bones A pedicled ulnar flap from the outer surface of the wrist was passed over the ends of the bones and the tip was brought to the radial side of the joint where it was fastened A radial flap was interposed in like manner The arm was dressed in slight anterior flexion and held in an elevated position

Five weeks later Murphy operated on the other wrist the

posed and rounded and a large flap of superficial fascia turned in from the surface of the pectoralis major The wound was closed and the arm put up with the shoulder abducted 45° Active abduction to 45° flexion to 45° and 60° rotation resu ted Passive abduction and flexion could be obtained to 90°

Wrist

For most purposes a wrist ankylosed in hyperextension permits satisfactory function with undiminished strength in the fingers (Figs 90 91)Occasionally however lateral and flexed motions are desirable in which case mobilization may be attempted

Only a few cases of arthroplasties of the wrist have been reported

Hoffa (24) records a case done by Nelaton and Oubredanne (108) in 1905 They resected the first row of carpal bones and interposed a tendon muscular flap The outcome was poor ankylosis recurred in four months

Hoffa (24) himself did two wrist arthroplasties On one he inserted a magnesium plate A fistu'a resulted which necessitated the removal of the plate ankylosis recurred In the other operation he resected the first row of carpal bones and inserted a fat and fascia flap taken from the proximal side of the wound Two months after the operation there was free motion of several degrees Nine months later there was good mobility in the wrist and excellent function

Stein (55) in 1907 in Bier s clinic did an arch shaped resection of the bones and interposed a muscle flap In two years the passive motion was good but the function was unsatisfactory due to the patient s cutting the flexor tendons

Baer (38c) in 1909 reported a case of congenital union between the head of the radius and the ulna Chromicized pig s bladder was interposed Three months after the operation supination was possib'e to 100° but a twist in the radius prevented it going further

Two more cases were cited by Baer (38a) in 1918 One of congenital synostosis of the radial head and ulna in which the membrane was used gave voluntary motion of 110° Marked curvature of the radius made normal conditions impossible

ed inward An incision was then made over the capsule of the old joint which was carefully saved and retracted laterally With a curved chisel the scaphoid and semilunar were separated by osteotomy from the radius (Fig 99) The lower end of the radius was re shaped and made to approximate as near as possible the normal radial end One fourth inch of the carpus was removed and the carpus very carefully rounded to conform to the opposing radial end (Fig 100) A piece of fascia was then removed from the outer side of the lower thigh of the right leg and sewed between these surfaces with interrupted chromic gut It was sutured first to the anterior capsule of the joint then to the posterior capsule well over the head of the radius (Figs 101 102) The old capsule of the joint was then closed with interrupted chromic catgut and the skin was closed with continuous catgut The hand was placed in a cast in hyper extension The plaster was allowed to remain on three weeks and then was split down the side and gentle passive motions begun (Figs 103 104) Active motions were encouraged

November 20 1922 Treatment continued There was no discharge An X Ray showed separation between carpus and radius as a rsult of arthroplasty (Figs 105 106)

November 27 1922 Hand was in good condition No pain and use of the fingers had increased Hyperextension splint applied To have daily baking and massage with motion

January 22 1923 There was 10 lateral motion in the wrist hand flexion 10° hyperextension 35 to 40 (Figs 107 108) The patient could almost make a fist His inability to complet ely close fingers was due to the old sepsis involving the sheaths of the tendons He has no pain and wishes to go to work

I feel the function will increase as time goes on

FINGERS

Unfortunately the phalangea' joints lend themselves poorly to plastic work due to the fact that in most cases the injury which causes the ankylosis also damages the tendon sheaths and the tendons As a result rapid and extensive atrophy follows rendering the skin and subcutaneous tissue very deli cate So tender are all the structures with which the operator

carpal bones and ulna and radius of which were completely ankylosed Only a radial incision was made The lower ends of the ulna and radius were resected about 5/8 to 3/4 The division of the ankylosis was semicircular with concavity upward A flap from the dorsum of the radial side of the forearm was interposed and fastened to the joint capsule on the ulnar side

The right wrist had an almost normal conformation the left wrist luxated slightly

In 1922 I did an arthroplasty in the following case

Case I E M On May 12 1922 patient fell through a pane of glass cutting the right wrist This was followed by infection resulting in ankylosis in deformity of 25 flexion Scars from numerous incisions during sepsis were present

When I first saw the patient he had power in all tendon groups but was unable to make a fist and the wrist was ankylosed in 25 flexion deformity Radiograms showed considerable atrophy and periarthritic changes with some posterior displacement of the tip of the ulna (Figs 92 93) Manipulation into the hyperextended position was done in August 1922 and a plaster applied

August 23 1922 Patient could bend fingers Use encouraged while in plaster

September 25 1922 Plaster removed and hyperextension splint applied Baking and massage daily Wrist in good position and although motion of fingers had increased and the wrist was in hyperextended position there was no wrist joint motion (Figs 93 94 95)

October 30 1922 Radiogram shows ankylosis between the scaphoid semilunar and the end of the radius (Figs 96 97) Arthroplasty of the wrist was advised

November 7 1922 Operation

OPERATIVE TECHNIQUE AUTHOR'S METHOD

Posterior incision 5 long (Fig 98) Skin and superficial fascia clamped off with towels Incision then made over fascia and posterior ligament and both retracted Common extensors retracted outward and the extensors of the thumb were retract

ed inward An incision was then made over the capsule of the old joint which was carefully saved and retracted laterally With a curved chisel the scaphoid and semilunar were separated by osteotomy from the radius (Fig 99) The lower end of the radius was re shaped and made to approximate as near as possible the normal radial end One fourth inch of the carpus was removed and the carpus very carefully rounder to conform to the opposing radial end (Fig 100) A piece of fascia was then removed from the outer side of the lower thigh of the right leg and sewed between these surfaces with interrupted chromic gut It was sutured first to the anterior capsule of the joint then to the posterior capsule well over the head of the radius (Figs 101 102) The old capsule of the joint was then closed with interrupted chromic catgut and the skin was closed with continuous catgut The hand was placed in a cast in hyper extension The plaster was allowed to remain on three weeks and then was split down the side and gentle passive motions begun (Figs 103 104) Active motions were encouraged

November 20 1922 Treatment continued There was no discharge An X Ray showed separation between carpus and radius as a rsult of arthroplasty (Figs 105, 106)

November 27 1922 Hand was in good condition No pain and use of the fingers had increased Hyperextension splint applied To have daily baking and massage with motion

January 22 1923 There was 10 lateral motion in the wrist hand flexion 10° hyperextension 35 to 40° (Figs 107 108) The patient could almost make a fist His inability to complet ely close fingers was due to the old sepsis involving the sheaths of the tendons He has no pain and wishes to go to work

I feel the function will increase as time goes on

FINGERS

Unfortunately the phalangeal joints lend themselves poorly to plastic work due to the fact that in most cases the injury which causes the ankylosis also damages the tendon sheaths and the tendons As a result rapid and extensive atrophy follows rendering the skin and subcutaneous tissue very deli cate So tender are all the structures with which the operator

comes in contact that even though he uses the best technique he is baffled Not until the metacarpal row is reached can the operator feel that the chances of success favor plastic work and here only in the presence of intact tendons and sheaths

In 1908 Hofmann (5b) reported a case of fibrous ankylosis of two interphalangeal joints of the same hand in which he interposed periosteal transplants from the tibia Six weeks after the operation there was good passive but no active mobility

Elcesser (15) secured a good result by implanting a finger joint from the cadaver

Goebell (16) also obtained a good movable joint by implanting a toe joint in a finger resected for severe arthritis deformans mans

Hammesfahr (133) in 1922 reported tran planting the joint of the second toe with cap ule and ligaments between the proximal phalanx of the middle hand bone The re u t has been very satisfactory the patient can move the joint freely in all directions there is only slight lack of b nding ability

In 1922 Oehlecker (184) reported good results after six years in transplanting the entire finger joints taken from the patients themselves and from other persons The results in the autoplastic cases were the better

Roepke (68) in 1913 operated for finger joint ankylosis and mentioned that he had success with free fat transplantation

Payr (74b) in 1914 recommended arthroplasty of the finger using pedunculated implants of flaps of tendon sheath from the palmar side of the hand He reported two arthroplasties of the interphalangeal joints with favorable results

Gallagher (109) in 1915 reported the result of an arthroplasty for traumatic bony ankylosis of a proximal interphalangeal joint of the fourth finger He does not describe his method In two months the patient could lift and carry on the joint 7 3/4 pounds There was voluntary flexion to about 45 and extension to about 170° He has devised a simple apparatus to give proper exercise to the joint

Hamilton (110) reported success in arthroplasties on the phalangeal and metacarpo phalangeal joints The same principles are involved as in arthroplasty on the larger joints The incision for all phalangeal joints is made parallel to the long axis

of the finger A mid lateral incision is made on either side down to the capsular ligament For metacarpo phalangeal joints an incision is made at the junction of the posterior and lateral surfaces on either side The bones are mobilized by sawing two nicks about 1/6 apart All fragments of capsular ligament are removed In the thumb he recommends the use of a free flap Extension is applied by means of a splint and adhesive plaster Passive motion is instituted after two or three weeks A case is cited of virulent polyarthritis which left a man with bony ankylosis of the thumb joint and proximal phalangeal joint of the index finger of the right hand Within six months after arthroplasty the patient was accepted as a naval recruit by the United States Navy

Verral (95) in 1920 reported his belief that the proximal joints can be treated by arthroplasty using free fascial graft Metacarpo phalangeal joints afford a good field for the first second and fifth fingers enough subcutaneous tissue can be obtained locally for the third and fourth fingers he used fascia lata The flap is cut in a strip 3 x 1 folded in half and sewed up into a bag which is slipped over the metacarpal head and secured by catgut

Hesse (140) in 1922 reported on fourteen cases of finger mobilization On the middle joint he made a lateral incision resected the head of the basal phalanx after separation of the lateral ligaments In two cases a layer of periosteum from the tibia was placed over the resected end In ten months one patient had complete working ability of the finger In three and one half months the other patient had active mobility 120° and normal extension In the twelve other cases free fascia lata transplantation was used In ten cases the patients were benefitted securing satisfactory mobility In one case the fascia sloughed and there was no betterment In another case there was shortening to about 2 cms active motion in the basal joint 100° but no movement in the middle joint and strong lateral motion In four of the cases it was necessary to remove the fascia

ANKLE

Ankylosis of the tibio astragaloid joint if at a right angle without varus or valgus is a functional joint with which in my opinion we should not interfere Although a weight bearing joint may be obtained from arthroplasty instability pain and sensitiveness may result

In a slight ankylosis of the ankle in good position there is only a slight limp If after experience in years to come stability may be assured with an arc of motion without pain and sensitiveness then and only then will arthroplasty be indicated

Ochsner (124) in 1912 reported that in case operation was necessary for ankle deformities he used the resection method removing the necessary amount of bone in a transverse line His cases have been successful and the patients can usual walk in two weeks In case of severe ankylosis without deformity he is opposed to arthroplasty

Ashhurst (77) in 1915 cited the case of a boy with bony ankylosis of the right ankle with the foot in a position of equinus at 140° with the leg There were deep scars on the leg and foot Ashhurst incised down to the bone on the outer side of the tarsus from below the external malleolus to the exten or tendons The soft parts were raised from the bones Another incision 1 long was made on the inner side of the ankle joint in front of the internal malleolus and parallel to the tibia The wounds were joined by burrowing A wedge of bone cut with its base on the dorsum of the tarsus and its apex at the posterior surface of the ankle joint rendered the foot movable Fascia lata from the left thigh was inserted The result was free voluntary motion of about 10° with the foot not quite at a right angle The hallux valgus cau ed extreme deformity

A second operation was performed in which the head of the metatarsal was removed and the toe put in position The tendon of abduction hallucis was inserted The tendo Achilles was lengthened by the «Z» operation One month later there was free voluntary motion in the ankle from 85 to 95° and passive motion from 85° to 110 Dr Ashhurst looked for further improvement

One would hardly feel that 10° motion in an ankle warrant the attempt to mobilize it An ankylosis corrected into pro

per position would be useful and mobilization might result in a sore and painful joint

Steindler (46) in 1916 reported two cases in which pedunculated fascia flaps were used One case was the result of a fracture of the astragalus and collum astragali, with supination deformity and the other the result of fracture of the internal and external malleolus and impingement of the body of the astragalus on the fractured end of the tibia and fibula No results were recorded

Ceballos (116) in 1917 used a free flap of fascia lata in a case of complete tibiotarsal ankylosis in a right angle No result is given

Baer s (38a) one case of arthroplasty on the ankle was reported in 1918 It is of interest as a bone graft of fibula was inserted before the arthroplasty could be made The membrane was inserted between the astragolus and the fibula Voluntary motion of 30° was obtained and the patient walks with comfort

Reich (125) in 1919 issued his views on arthroplasty of the ankle joint which he considered one of the most satisfactory mobilizations Observations were made in various operated cases which showed that the desired 20° to 30° range of mobility was not obtained This Reich believed was because in operation the tibia was again made concave and the astragalus convex As the mobility attained by the natural joint is closely connected with the height of the astragalus over the posterior segment of the foot the slightest diminution of this height interferes with the excursion for the margins of the concave plane of the tibia strike against the astragalus anteriorly and posteriorly In arthroplasty a decrease in the height of the astragalus seems unavoidable

Reich recommended an inversion of the natural form of the portions of the joint making the surface of the tibia convex and the astragalus concave The flaps of fat are laid between the surfaces With this inversion the axis of the joint mobility will be changed downward without the lateral ligaments being adapted to it but this new mobility is not so much of the joint as of the rocking motion which furnishes a useful substitute for the former

ANKLE

Ankylosis of the tibio astragaloid joint if at a right angle without varus or valgus is a functional joint with which in my opinion we should not interfere Although a weight bearing joint may be obtained from arthroplasty instability pain and sensitiveness may result

In a s'ight ankylosis of the ankle in good position there is only a slight limp If after experience in years to come sta bility may be assured with an arc of motion without pain and sensitiveness then and only then will arthroplasty be indicated

Ochsner (124) in 1912 reported that in case operation was necessary for ankle deformities he used the resection method removing the necessary amount of bone in a transverse line His cases have been successful and the patients can usual walk in two weeks In case of severe ankylosis without defor mity he is opposed to arthroplasty

Ashhurst (77) in 1915 cited the case of a boy with bony anky losis of the right ankle with the foot in a position of equinus at 140 with the leg There were deep scars on the leg and foot Ashhurst incised down to the bone on the outer side of the tarsus from below the external malleolus to the exten or tendons The soft parts were raised from the bones Another incision l long was made on the inner side of the ankle joint in front of the internal malleolus and parallel to the tibia The wounds were joined by burrowing A wedge of bone cut with its base on the dorsum of the tarsus and its apex at the poste rior surface of the ankle joint rendered the foot movable Fascia lata from the left thigh was inserted The resu t was free voluntary motion of about 10° with the foot not quite at a right angle The hallux valgus cau ed extreme deformity

A second operation was performed in which the head of the metatarsal was removed and the toe put in position The ten don of abduction hallucis was inserted The tendc Achilles was lengthened by the «Z» operation One month later there was free voluntary motion in the ankle from 85 to 95° and passive motion from 85° to 110 Dr Ashhurst looked for further improvement

One would hard y feel that 10° motion in an ankle warrant the attempt to mobilize it An ankylosis corrected into pro

for a case of double hallux valgus using the technique I have outlined

For years this patient had complained of increasing pain and stiffening in the toe joints More recently she complained of loss of loss motion and enlargement of the joints Physical examination showed a marked exostosis on the top and inside of both toe joints with limited motion Excision of the distal head of the first metatarsus and insertion of a bursal flap was advised

February 1921 In the operation 1/2 of the distal head of the first metatarsus was removed

April 8 1921 Good motion Anterior arch padding

Subsequent convalescence without pain or swelling Elastic cuffs advised

November 17 1922 Motion perfect (Figs 115 116 117 118 119 120)

Murphy (36b) in 1913 secured good motion in eighteen days in a case of ankylosis of the phalangeal and metatarso phalangeal joints Leucorrhea of four years duration had been the cause of stiffness Murphy made an incision on the dorsum of the toe and used a flap of fat and fascia from the inner side of the foot with base upward

In 1916 Murphy (36b) outlined his operative technique for hallux rigidus as follows A curved incision with convexity outward along the extensor tendon incision of the tendon to elongate it metatarsal head resected and bursal capsule used as the interposing flap

Putti (50a) in 1913 reported an arthroplasty on an ankylosed metatarsal phalanx of the hallux He made a longitudinal cut on the internal side of the metatarsal phalanx removed two large sesamoids that contributed to the stiffness removed all capsule and interposed a flap of fascia lata wrapping the two surfaces The extensor tendon was shortened A plaster cast was applied to keep the hallux in a dorsal position The post operative treatment was regular The stitches were removed on the ninth day and gentle passive movement was begun

METATARSO PHALANGEAL JOINTS

The metatarso phalangeal joints with the exception of the first metatarso phalangeal joint never call for arthroplastic measures These joints in fact are rarely stiff The fascia flap method gives an excellent result in the operation on the first metatarso phalangeal joint

OPERATIVE TECHNIQUE AUTHOR'S METHOD

After thorough preparation of the part and the application of a tourniquet an incision is made beginning on the lateral aspect of the first phalanx and extending parallel to the shaft curving to the lateral dorsal surface over the region of the joint and then back to the lateral aspect of the first metatarsal (Fig 109) This flap is then disssected down and retracted with double hooks A curved incision is then made through all remaining tissue including bursa capsule and fascia This incision begins near the base of the first metatarsal on the lateral plantar surface and sweeps about 1/4 over the base of the first phalanx to a corresponding position on the lateral dorsal aspect of the first metatarsal The flap is dissected back exposing the old joint (Fig 110) About 5/8 of the head of the first metatarsal is then removed and all edges smoothed with a file or shoemaker s rasp (very important) (Figs 111 112 113) A chromic suture is then passed from the plantar surface into the cavity and through the flap making a mattress suture and then the needle is passed through the cavity to the outer plantar surface and the flap firmly pulled into the cavity over the end of the metatarsal head (Fig 114) The skin is closed with continuous catgut and a dry dressing applied The toe is bandaged in inversion and slight plantar flexion opposite to the usual deformity

Weight bearing is allowed in two or three weeks at which time passive motion and hydrotherapy are of use Activity depends upon the amount of swelling and pain and motion is limited accordingly The results of mobilization of the joint are excellent

Case I D R Age 45 years In February 1921 I operated

22 Ollier, Traité des résections et des opérations conservatrices, etc., Paris, 1885.

23 Orlow, L. W. (*Deutsche Zeitschr. f. Chir. Leipz.* LXVI, 399.)

24 Hoffa (*Zeit. f. Orthop. Chir.* XVII, 1906, 1.)

25 Chlumsky (*Zentral. f. Chir.* 1900, XXVII, 921.)

26 Taylor (*Penna. M. J.* 1912, XVI, 294.)

27 Bilczynski (*Zentralbl. f. Chirurgie* 1898.)

28 Mikulicz (*Verhandl. d. deutsche Gesellsch. f. Chir.* Berlin, XXIV, II, 350.)

29 Kuznetsoff, Vrach, St Petersb. 1898, XIX, 1275, 1311.

30 Gluck (Th. *Deutsche med. Presse* VII, 1.)

31 Huguier (*a*) Thèse de doct. Paris, 1905.
(*b*) *Tribune Méd. Paris* n. s. XLI, 1909, 197.

32 Quénu (*a*) *Bull. et Mém. Soc. Chir. Paris* 1902, XXVIII, 724.
(*b*) 1903, XXIX, 112.
(*c*) 1905, XXXI, 622.

33 Albarran cited by Hoffa *loc. cit.*

34 Nélaton (*Bull. et Mém. Soc. Chir. Paris* 1902, XXVIII, 687.)

35 Delbet (*a*) *Bull. et Mém. Soc. Chir. Paris* 1903, XXIX, 1172.
(*b*) *Ann. de la Policlin. de Paris* 1912, XXIII, 284.

36 Murphy (*a*) *Tr. Am. Surg. Ass'n* 1904, XXII, 313.
(*b*) *Ann. Surg.* 1913, LVII, 593.
(*c*) *Murphy's Clinics* 1914, III, 523, 1159.
(*d*) *J. Am. M. Ass'n* 1915, 851.
(*e*) *Murphy's Clinics* 1916, V, 641, 189, 07.
(*f*) *Tr. Am. Surg. Ass'n* Philadelphia 1913, XXXI, XXX, 126.
(*g*) J. *Am. M. Ass'n* Chicago 1905, XLIV, 1573, 1671, 1479.

BIBLIOGRAPHY

1 BARTON J Rhea (N A Med Jour 1827)
2 RODGERS (N Y J of Med & Surg 1840)
3 BÉRARD (Dict de Méd 1838, XXIII 440)
4 RECHFT VIII Cong Chir Lyon 1894 (Arch pro chir 1896)
5 HOFMANN (a) Ztschr f orthop Chir 1906, XVII, 1
(b) Beitr z klin Chir Tübingen, 1918, LIX 717)
6 WEGLOWSKI (Zentralbl f Chir 1907 Apr 27)
7 VON FRISCH (Wien klin Wochenschr 1911 XXIV 922)
8 GREIFFENHAGEN (St Petersb med Ztschr 1913 XXXVIII 93)
9 MAUCLAIRE (Bull Med Paris 1913 XXVII, 66)
10 DELANGIERE (Bull et Mem Soc Chir Paris 1917 XLIII, 2195)
11 WOLFF (Verhandl der Deutschen Gesellschaft für Chir 1882)
12 SAYRE A New Op for Hip Joint in Bony Ankylosis, N Y, 1869
13 LEXER (Surg Gyn & Obst 1908 VI 601)
14 HERZBERG Dissertation Berlin 1913
15 ELOESSER Calif St J M San Francico, 1913 XI 485
16 GOEBELL W (Muenchen med Wochenschr 1913 LX, 356)
17 VAUGHAN G T (Surg Gyn & Obst Chicago 1911, XIII 80)
18 KUTTNER (Beitr z klin Chir Tubing 1911, LXXV 1)
19 AXHAUSEN G (Beihefte z med Klin Berlin 1908 IV 23)
20 VERNEUIL (Arch de Méd 1860)
21 HELFERICH a) Verhandl d Deutsch Gesellsch f Chir 1894 XXIII 504
b) Centralbl f Chir 1894 suppl p 35

58 REINER (*Deutsche Zeitschr f Chir* 1910, CIV, 209)
59 OSGOOD (*Boston M & S J* 1911, CLXV 86)
60 WHITMAN (*Ann Surg* 1911, LIV, 860, 1916, LXIII, 503)
61 EDMUNDS (*Med Press & Circ* 1912, XCIV 574)
62 DENK (*Arch f Klin Chir* 1912 XCVII, 458)
63 DELBET (*Gaz Méd de Paris* 1912, LXXXIII 117)
64 CHAPUT (*a*) *Bull et Mem Soc de Chir de Paris* 1912, XXXVIII, 452,
(*b*) 1915 XLI, 1540
65 CORNER (*Méd Press & Circ* London, 1913, N S CXVI 723)
66 CONRAD Dissertation Kiel, 1912
67 POMPONI (*Gior di Med Mil* 1912 LX 418)
68 ROEPKE (*Deutsche Chir Kong* 1913 116)
69 FASNER (*Wien Klin Wochenschr* 1913, XXVI, 1821)
70 DARLING (*Phys & Surg* 1913, XXXV 71)
71 HARRIS (*Texas St J M* 1913, IX, 213)
72 TURNER (*Edinburgh M J* 1914, XII, 433)
73 VULPIUS (*Muenchen Med Wochenschr* 1914, Mar 17)
74 PAYR (*a*) *Deutsche Zeitschr f Chir* 1914, CXXIX, 341
(*b*) *Arch f Klin Chir* 1914, CVI, 235
75 PUPOVAC (*Wien Med Wochenschr* 1914 XXVII, 151)
76 OWEN (*Ann Surg* 1914, LIX, 426)
77 ASHHURST (*Ann Surg* 1915 LXII, 302 378)
78 GILBERT (*Texas St M J* 1915 XXXI 226)
79 TUBBY (*a*) *Am J Orthop Surg* 1915, XII 433, 377
(*b*) *Méd Presse & Cir* Londres 1914, n s XCVIII 324
80 KENNEDY (*Tr Roy Acad M Ireland* Dublin 1915, XXXIII, 223
81 MACAUSLAND (*a*) *J Am Ass n* Chicago, 1915 LXIV, 312
(*b*) *S Clinics N America* 2 959, Aug 1922,
(*c*) *Surg Gyn & Obst* septembre, 1921, 223
82 BROWN W I & C P (*J Am M Assoc* Chicago, 1914 LXII 1389)

37 BERGER (*Bull et Mém Soc Chir Paris* 1901, XXIX 998)
38 BAER (a) *Am Jour Surg* 1918 XXI, 170
(b) *Tr So Surg Ass n* 1916 Philadelphia 1917 XXX, 126,
(c) *Johns Hopkins Hosp Bull* Baltimore 1909 XX 271
39 ALLISON and BROOKS (*Surg Gyn & Obst* 1913 XVII 645)
40 NEFF (*Surg Gyn & Obst* Chicago 1912, XV 59- 55)
41 DAVIS (*Johns Hopkins Bull* 1911)
42 KOLAZEK (*Beitz Klin Chir* 191 LXXXIII 755)
43 SUMITA (*Arch f Chir* Berlin 1912 XCIX, 755 815)
44 ELY BONE and JOINT STUDIES (*Le St Junior U Publ* 1916)
45 HOHMEIER & MAGNUS (*Verhandl d Deut Gesell f Chir* 1914)
46 STEINDLER A J Iowa St M Soc Des Moines 1916, VI 284
47 CARNOCHAN (*Archives de Médecine* 1860 284)
48 SCHANZ (*Muenchen Med Wochenschr* 1904 2-28)
49 THOM V (*Deutsche Ztschr f Chir* Leipzig CVIII 1910'11 424)
50 PUTTI (a) *Arch d Orthop* Milano 1913 XXX 1 -05
(b) *Chir d Org di Movimento* Bologna 1919 III 6-7
(c) *J Orth Surg* 191- III 4 1
(d) *Chir d Org di Movimento* Bologna 1917 I
(e) *Arch di Orthop* Milano 1919 XXXV -7-
(f) *J Orth Surg* Lincoln Neb 19-0 II 5-0
51 DUPUY Thèse de doct Toulouse 1903
52 PEREIRA (*Brazil Méd* Rio de Janeiro 1906 XX 361) 1907 XLV 297 1908 XLVII 711)
53 SCUDDER (*Boston M & S J* 1906 CLX 375 *Ann Surg*
54 BAZY (*Bull et Mém Soc Chir Paris* 1907 XXXII 5 0)
55 STEIN Dissertation Bonn 1907
56 WIENER (*Am J Surg* New York 1911 XXV -81)
57 CIFUENTES (*Rev de Espec Med* Madrid 1909 XII 73)

111 AHRENS (*Muenchen Med Wochenschr* 1908, IV, 2138)
112 PETTIS (*Phys & Surg Detroit & Ann Arbor* 1913 XXXV, 352)
113 TORREY (*J Mich M Soc* Grand Rapids, 1913 XII, 318)
114 CLARK (*Méd Press & Circ* London, 1914, n s XCVII, 30)
115 BALDWIN (*West London M J* 1915 XX, 111)
116 CEBALLOS (*Prensa Med Argentina* Buenos Aires, 1917, IV, 400)
117 BURLEW (*Calif St J M* San Francisco 1918 XVI 237)
118 KOCHER, Chirurg Operations Lehre
119 BIERMANN Karl, 1909 Die funktionellen Resultate der Gelenk resectionem mit besonderer Beruc sichtigung der Methoden di zur Erhaltung der Beweglichkeit Diss Berlin
120 CARR (*Tr So Surg Ass n* Philadelphia 1917, 161)
121 BROWN (*Calif St J M* 1916 XIV 146)
122 DURANTE Trattado di Medicina Operatoria di Durante e Leotta, vol II (*Chirugia degli Arti* 113)
123 ROSER (*Zentralblatt fur Chirurgie* 1886, 36)
124 OCHSNER (*Illinois M J* Springfield 1912 XXXI 596)
125 REICH A, (*Zentralb f Chirurgie* 1919 XLVI, n° 6, 97)
126 WHITACRE (*Lancet Clinic Cincin* 1908 XCIX, 424)
127 WILLE (*Norsl Mag f Laegevidensl*, 1911 IX, 40)
128 ALPH (*Deutsche Zeitschr f Chir* Leipzig 1916, CXXXVI 508)
129 DOUGLAS (*Ann Surg* Philadelphia 1920 LXXII, 636)
130 KIRSCHNER (*Verhandl d Deutsch Gesellsch f Orthop Chir* 10 Kong Berlin 1910 222)
131 QUIGLEY D T & STEVENSON F C (*West M Rev* Omaha 1913 XVIII 137)
132 HALLOPEAU P (*Bull et Mém Soc de Chir de Paris* 1920 XLVI 1447)
133 HAMMESFAHR (*Deutsche med Wochenschrift* Berlin et Leipzig 1912 XXXVIII 390)
134 HENLE Diss A Lesser, Tubingen 1898
135 HUEBSCHER C (*Correspondenzbl f Schweiz Arzte* decembre 1915, XXXI, 785)

83 ROVSING (*Tr XI North Surg Cong* Gotenb 1916)

84 MOSZKOWICZ (*Berl Zeitschr f Chir* 1917 CV, 168)

85 CROSTI (*Atti d Soc lomb di sc* Med e Biol, Milano 1916-17, VI, 48)

86 PLUMMER (*Surg Gyn & Obst* 1917 XXIV 509)

87 RYERSON (*Surg Clin Chicago* 1917, I, 197)

88 PRANDO (*Prensa Méd Argentina* Buenos Aires 1917 18 IV 399)

89 CICCARELLI (*Riforma Med* Napoli 1917 XXXIII, 1173)

90 OLIVIERI (*Semana Méd* Buenos Aires 1917, XXIV 127)

91 ALBEE (*Orthopedic and Reconstruction Surgery* 1918, 965)

92 HENDERSON (*Am J Surg* 1918 XXI 30)

93 KERR (*Surg Gyn & Obst* 1920, XXX 518)

94 HOHMANN (*Berl Klin Wochenschr* 1918 LV, 222)

95 VERRAL P J (*Clin J Lond* 1920 XLIX 76)

96 CRAMER (*Archiv f Klin Chir* 1901)

97 HOKE and ANDREWS (*Atlanta Jour Rec Med* 1908, X 132)

98 Mc CURDY (*Penn M J* Athens 1914 15 XVIII 606)

99 PRINGLE (*Tr Roy Acad M* Ireland Dublin 1915 XXXIII 240)

100 Mc KENNA (*J Am M Ass n* 1917 LXIX 891)

101 BRANDSTRUP (*Hospitaltidende* 1917 n 27, 663 Mar 25 1917)

102 FINOCHIETTO (*Semana Méd* Buenos Aires 1918 XXV 590)

103 HESSERT (*Surg Clin Chicago* 1918 II 129)

104 GODDU (*Boston M & S* 1921 CLXXXIV 198)

105 OGILVY (*N Y M J* 1921 CXIV 566)

106 CAMPBELL (*a*) *J Orthop Surg* 1921 III 430)
(*b*) *Annals of Surg* novembre 1922 615

107 DURAN, L (*Revista Ibero Amer Scienc Med* Madrid 1910 XXII, 366)

108 NELATON and OMBRÉDANNE (*Rév d Orthop* 1905 25 VI 39)

108 GALLAGHER R (*J Am M Ass n* Chicago, 1915 LXV 1180)

110 HAMILTON, G (*Tex St J M* Fort Worth 1919 XIV 353)

111 Aikens (*Muenchen Med Wochenschr* 1908, IV, 2138)
112 Pettis (*Phys & Surg Detroit & Ann Arbor* 1913 XXXV 35)
113 Torrey (*J Mich M Soc* Grand Rapids 1913 XII, 318)
114 Clak (*Méd Press & Circ* London 1914 n s XCVII, 30)
115 Baldwin (*West London M J* 1915 XX 111)
116 Ceballos (*Prensa Med Argentina* Buenos Aires, 1917, IV, 400)
117 Burlew (*Calif St J M* San Francisco 1918 XVI 237)
118 Kocher Chirurg Operations Lehre
119 Biermann Karl 1909 Die funktionellen Resultate der Gelenk resectionem mit besonderer Beruc sichtigung der Methoden di zur Erhaltung der Beweglichkeit Diss Berlin
120 Carr (*Tr So Surg Ass n* Philadelphia 1917 161)
121 Brown (*Calif St J M* 1916 XIV 146)
122 Duranti Trattado di Medicina Operatoria di Durante e Leotta, vol II (*Chirugia degli Arti* 113)
123 Roser (*Zentralblatt fur Chirurgie* 1886, 36)
124 Ochsner (*Illinois M J* Sprinfield, 1912 XXXI 596)
125 Reich A (*Zentralb f Chirurgie* 1919 XLVI n° 6 97)
126 Whitacre (*Lancet Clinic Cincin* 1908 XCIX 424)
127 Wille (*Norsl Mag f Laegevidensk*, 1911, IX, 40)
128 Alpi (*Deutsche Zeitschr f Chir* Leipzig 1916 CXXXVI 508)
129 Douglas (*Ann Surg* Philadelphia 1920 LXXII, 636)
130 Kirschner (*Verhandl d Deutsch Gesellsch f Orthop Chir* 10 Kong Berlin 1910, 222)
131 Quigley D T & Stevinson, T C (*West M Rev* Omaha 1913 XVIII, 137)
132 Hallopeau P (*Bull et Mém Soc de Chir de Paris* 1920 XLVI 1447)
133 Hammesfahr (*Deutsche med Wochenschrift* Berlin et Leipzig 1912 XXXVIII, 390)
134 Hesle Diss, A Lesser, Tubingen 1898
135 Huebscher C (*Correspondenzbl f Schweiz Arzte* decembre 1915, XXXI 785)

136 IMBERT L (*Lyon Chir* 18, 57. septembre-octobre 1921)
137 JUDET Recherches de Chir expérimentale Baillère, Paris 1908
138 HORHAMMER (*Muenchen med Wochenschrift* 1917, LXIV 1338)
139 HOHLBAUM (*Arch f klin Chir* 117 647 avril 1 1922)
140 HESSE F (*Arch f klin Chir* 119 janvier, 1 1922)
141 KATZENSTEIN (*Berl klin Wochenschrift* 1916 n 24)
142 KLEINSCHMIDT (*Muenchen med Wochenschrift* 1919 LXVI 520)
143 KLAPP R (*Zentralbl f Chir* Leipzig 1909 XXXVI 1196)
144 KONIG (*Lehrb d Chir* 1894)
145 LENTZ Congrès français de Chirurgie 1895
146 LERICHE M R (*Lyon Chirurg* 1921 XVIII 547)
147 Mc ILHENNEY (*N Orleans M J* 1901)
148 MEYER (*Klin Abend* 18 octobre 1895)
149 MEYER O (*Deutsche med Wochenschrift* Leipzig u Berlin 1909 XXXV 1921)
150 THOMSON (*Edinburg M J* 1917 XIX 176)
151 BERESOWSKI cf ORLOW (*Deutsche Zeitschrift f Chir* Bd 36 1903 S 400 ff)
152 AMESAGA G DE (*Ann Surg* Philadelphia 1907 XLVI 617)
153 RINGEL (*Deutsche med Wochenschrift* Leipzig u Berlin 1916 XLII 713)
154 RITCHIE (*Journ Lancet* 40 479 septembre 1 1920)
155 ROCHET These de Fondet 1895
156 ROCHER (*J de Med de Bordeaux* 1920 1 215)
157 ROEREN (*Arch f Orthop Muench u Berl* 1922 XX 56)
158 SCHLOFFER (*Deutsche med Wochenschrift* Leipzig u Berlin 1917 XLIII 1183)
159 SCHMERZ (*Beitr z klin Chir* Tubingen 1911 LXXXI 261)
160 SCHMIDT (*Khirurgia Moscow* 1899)
161 SEGALE (*Beitr z klin Chir* Tubingen 1913 LXXXI 259)

162 Silfverskiöld (N J Am Ass'n Chicago 1922, LXXVIII 856)
163 Sourdat (*Médecine prat* Paris 1910 VI 806)
164 Sensmith (*J Méd Soc N J* Orange 19 0 XVIII, 333)
165 Sievers (*Freie Vereinigung der Chirurgen Sachsens* Leipzig 26 X, 1912 *Zentralbl f Chir* 1913 n 23)
166 Simon (*Berl klin Wochenschrift* 1914 LI 235)
167 Werdt (*Deutsche med Wochenschrift* Leipzig u Berlin 1916 XLII 1339)
168 Whitter W I de C (*Brit J Surg* Bristol 1921 IX 242)
169 Wollenberg (*Zeitschr f ärztl Fortbild* 1915 XII 267)
170 Woolsey (*Ann Surg Philadelphia* 19 0, LXXII 636)
171 Zeller (*Jahresk f ärztl Fortbild* 1919 12 Hft 25)
172 Blair (*Tr Soc & Gyn Ass'n* 1914 XXXI 435)
173 Bockenheimer (*Deutsche med Wochenschrift* 48 729 Juin 1922)
174 Bolognesi (*Arch internat de Chir* Gand 1912 13 VI 69)
175 Buchmann (*Zentralbl f Chir* 1908 n 19)
176 Cavazzani (*Gazz degli osped e della clin* 1899 37)
177 Chubb (*Brit M J* I 256 février 21 1920)
178 Ferguson (*Med Times & Gaz* 1861 I 601)
179 Foederl (*Prager Zeitschr f Heilkunde Bd* XVI H 4 Zentralbl f Chir, n 5 1896)
180 Gilpatrick (*Boston M & S J* 186 374 23 mars 1922)
181 Graff (*Deutsche med Wochenschrift* 1915 XLI 1502)
182 Grange C D O (*Lancet* 2 554, 11 septembre 19 0)
183 Narath (*Zentralbl f Chir* 1896)
184 Oehlecker (*J A M A* 79 778, 26 août 1922)
185 Painter (*Canada Lancet* Toronto 1912 13 XLVI 332)
186 Perthes (*Muenchen med Wochenschr* 1917 LXIV 919)
187 Petraschewskaja (*Verhandl d wiss Ver d Ärzte d stadt Obuchow Krankenh in Petersburg* 22 1913)
188 Phemister & Miller (*Surg Gyn & Obst* 1918, XXVI 400)

189 COTTON (*Surg Clinics of N A* août 1922 vol 2)
190 CZERNY (*Arch f Klin Chir* 1872 XIII 227)
191 DARTIGUES (*Revue d Orthopédie* 1900 XI)
192 DAUTREFLPONT (*Arch f Klin Chir* 1868 IX 917)
193 DEFONTAINE (*Revue de Chirurgie* 1887, n 9)
194 DIEL (*Gaz des Hôpitaux* Paris 1913 LXXXVI, 1727)
195 DEUTSCHLANDER (*Soc des Chir de l Allemagne du Sud Ouest* novembre 1911)
196 DUFOURMENTEL L et DARCISSA (*Bull Soc de Pédiat de Paris* 1921 XIX 62)
197 FAVERNIER (*Lyon Chirurg* 1920 XVI 527)
198 TEFFIER (*Soc de Chir* de R 1901)
199 TEXTOR (*Wurzburg* 1843 VIII 4)

Consulting Orthopedic Surgeon Union Hospital Fall River Mass St Luke s Hospital New Bedford Mass Burbank Hospital Fitchburg Mass House of Mercy Hospital Pittsfield Mass C T Plunkett Memorial Hospital Adams Mass Fairview Hospital Great Barrington Mass Framingham Hospital Framingham Mass St John s Hospital Lowell Mass Eliot Hospital Manchester N H Memorial Hospital Nashua N H St Joseph s Hospital Nashua N H Leominster Hospital Leominster Mass Choate Memorial Hospital Woburx Mass Medical Director Berkshire School for Crippled Children Pittsfield Mass Somerville Hospital Somerville Mass Elliot City Hospital Keen N H

SUMMARY

In his contribution entitled the « Mobilization of Stiff Joints » Dr W Russel Mac Ausland discusses the present status of arthroplasty emphasizing that this operation is not an excision He describes the types of ankylosis as infectious non tubercular and traumatic and enumerates the indications and contra indications for arthroplasty A careful statement is made as to the position in which stiff joints functionate best

After passing in review the methods previously used the author traces the development of arthroplasty including experimental processes from the time of Verneuil in 1860 to current methods Special reference is made to Dr Baer for his work with chromicized pig s bladder and to the late Dr John B Murphy for his successful development of the pedunculated flap as a transplant Free fascia for transnplantation in the experience of the author and in the work of Putti and Payr has proved most successful and given uniform results

The author makes a comprehensive study of each joint stating the indications and contra indications for operation and describes the general methods of treatment Each joint which favors arthroplasty is illustrated by drawings of operative technique by carefully tabulated records and photographs etc of not only the author s cases but of those of other surgeons All of the arthroplasties reported by operators in the various countries are enumerated stating the method used and where possible the result obtained

The author feels justified in advising arthroplastic measures in selected cases of ankylosis especially of elbow hip and knee joints

RESUME

Dans son article intitule la « Mobilisation des articulations raides » le docteur W Russel Mac Ausland discute l etat actuel de l arthroplastie insistant sur le fait que cette operation n est pas une excision Il decrit les types d ankyloses infectieuses non tuberculeuses et traumatiques et enumere les indications et les contre indications de l arthroplastie Un expose soigne nous explique la position dans laquelle les articulations raides fonctionnent le mieux

Apres avoir pas e en revue les methodes employees anterieurement l auteur montre le developpement de l arthroplastie y comprenant les processus experimentaux depuis Verneuil (en 1860) jusqu a nos jours Une mention speciale concerne le docteur Baer et son travail sur la vessie de porc chromisee et feu le docteur John B Murphy et le succes obtenu par sa transplantation de lambeaux pedicules L aponevrose libre pour la transplantation experimentee par l auteur et citee dans l ouvrage de Putti et Payr ont eu des resultats meilleurs e plus uniformes

L auteur fait une etude en detail de chaque articulation exposant les indications et contre indications operatoires et il decrit les methodes generales de traitement Chaque articulation justiciable de l arthroplastie est representee par des dessins montran la technique operatoire des tableaux des photographies etc non seulement des cas rencontres par l auteur mais de ceux d autres chirurgiens Toutes les arthroplasties rapportees par des operateurs dans les differents pays sont enumerees avec les methodes employees et si possible le resulta obtenu

L auteur croit pouvoir con eiller l arthroplastie dans certains cas d ankylose particulierement pour les articulations du coude de la hanche et du genou

ELBOW TECHNIQUE

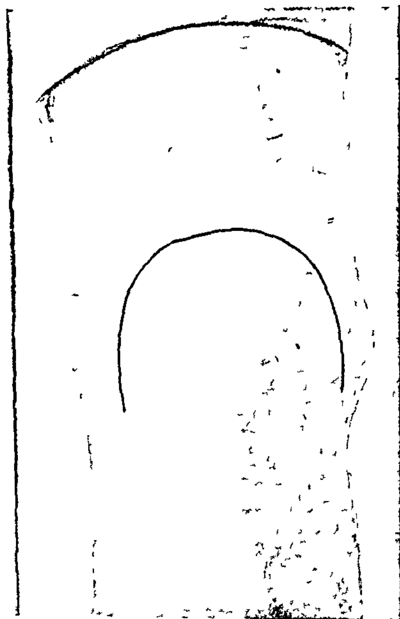


Fig 1 Line of incision

RESUME

Dans son article intitule la « Mobilisation des articulations raides » le docteur W Russel Mac Ausland discute l etat actuel de l arthroplastie insistant sur le fait que cette operation n est pas une excision Il decrit les types d ankyloses infectieuses non tuberculeuses et traumatiques et enumere les indications et les contre indications de l arthroplastie Un expose soigne nous explique la position dans laquelle les articulations raides fonctionnent le mieux

Apres avoir passe en revue les methodes employees anterieurement l auteur montre le developpement de l arthroplastie y comprenant les processus experimentaux depuis Verneuil (en 1860) jusqu a nos jours Une mention speciale concerne le docteur Baer et son travail sur la vessie de porc chromisee et feu le docteur John B Murphy et le succes obtenu par sa transplantation de lambeaux pedicules L aponevrose libre pour la transplantation experimentee par l auteur et citee dans l ouvrage de Putti et Payr ont eu des resultats meilleurs e plus uniformes

L auteur fait une etude en detail de chaque articulation exposant les indications et contre indications operatoires et il decrit les methodes generales de traitement Chaque articulation justiciable de l arthroplastie est representee par des dessins montran la technique operatoire des tableaux des photographies etc non seulement des cas rencontres par l auteur mais de ceux d autres chirurgiens Toutes les arthroplasties rapportees par des operateurs dans les differents pays sont enumerees avec les methodes employees et si possible le resulta obtenu

L auteur croit pouvoir conseiller l arthroplastie dans certains cas d ankylose particulierement pour les articulations du coude de la hanche et du genou

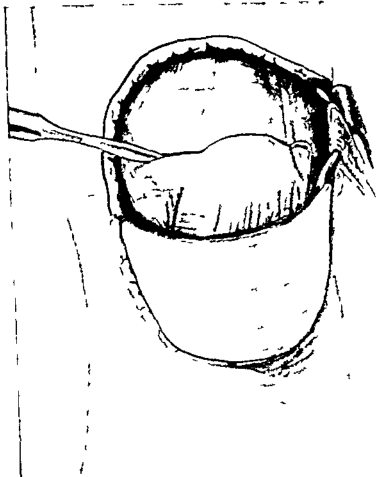


Fig 3 Cutting through the Muscle and Fascia down to the joint

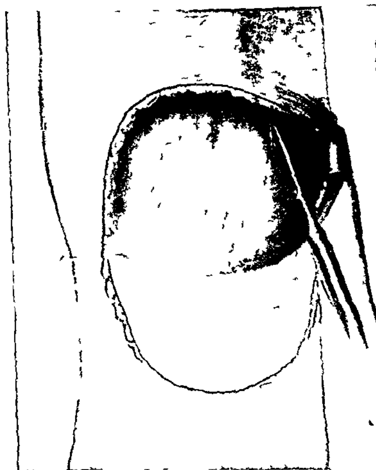


Fig 2 Dissecting out Ulnar Nerve

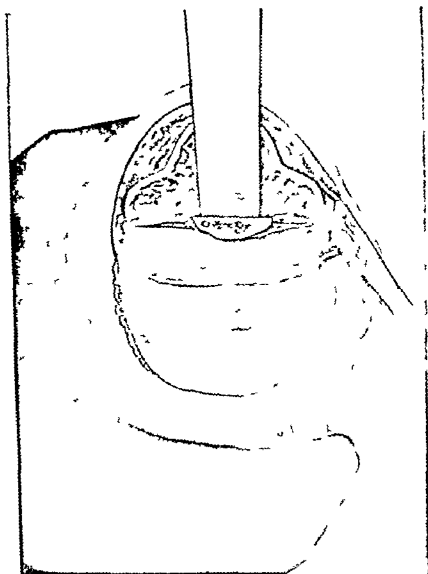


Fig 5 Splitting off tip of Olecranon with chisel

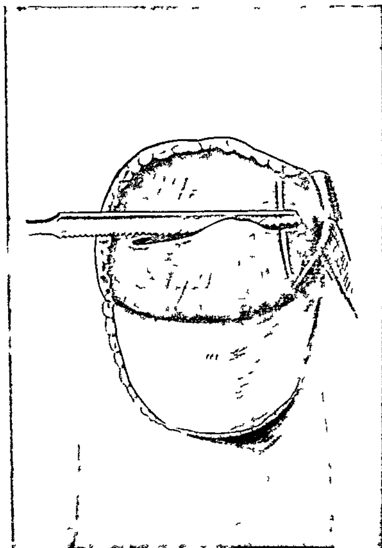


Fig 4 Sawing through Olecranon and d of Humerus

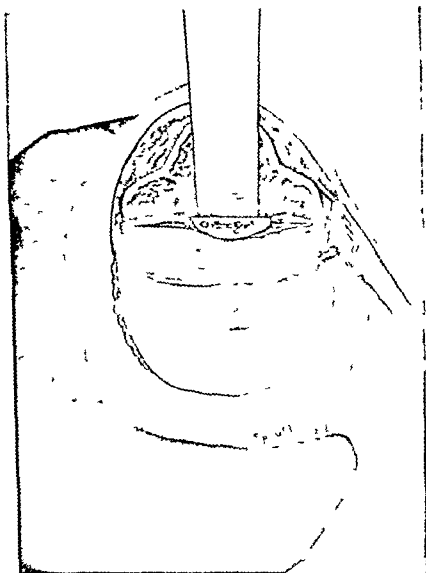


Fig 5 Splitting off tip of Olecranon with chisel

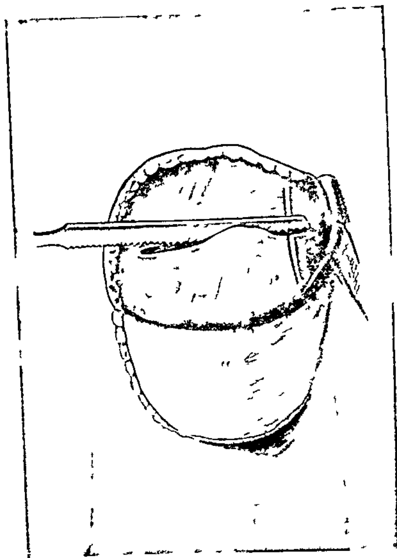


Fig 4 Sawing through Olecranon and end of Humerus.

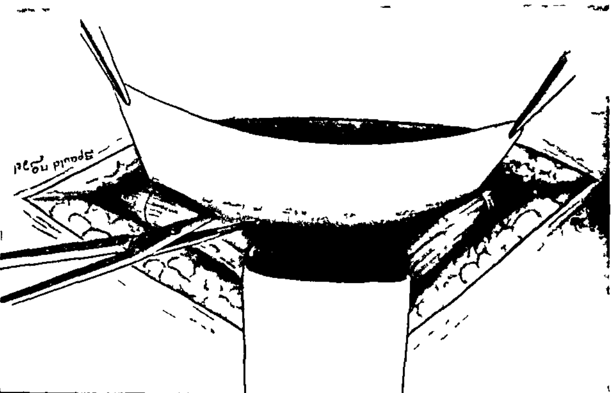


Fig 8 Cutting Fascia Lata from Thigh

Fig 6 Cutting out with Rongeur Forceps bit of Olecranon tip left in Humerus

Fig 7 Scooping out Ulna and Radius with Curette

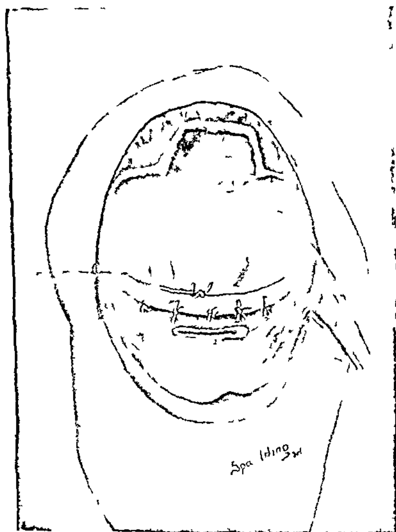


Fig 10 Fascia sewed ove Humerus tied with chrom c catgut suture

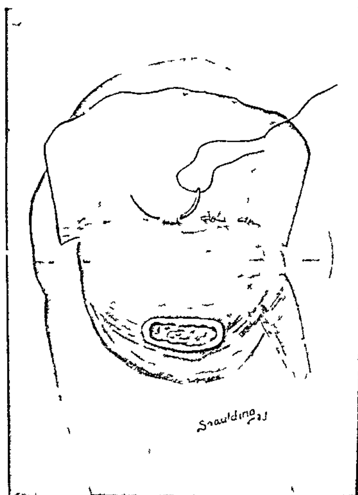


Fig. 9 Sewing the flap of Fasci Lat to the Elbow joint anteriorly

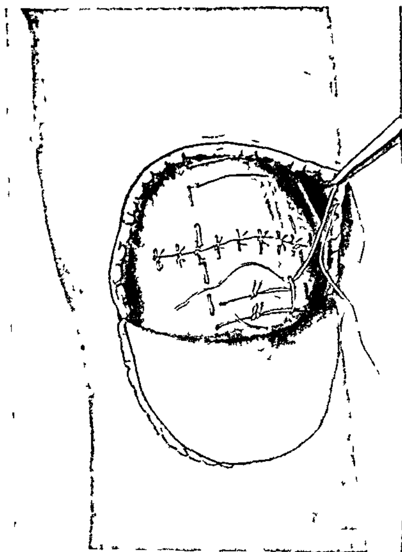


Fig 12 Stay sutures

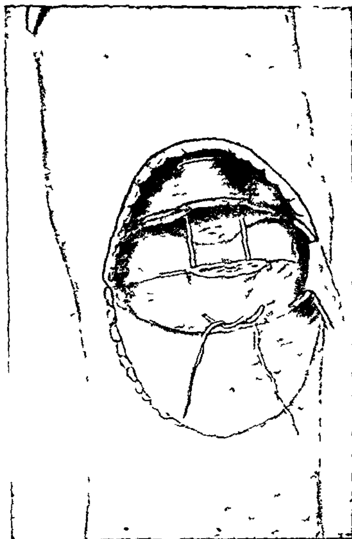


Fig 11 Kangaroo suture through Ulna and Olecranon tip

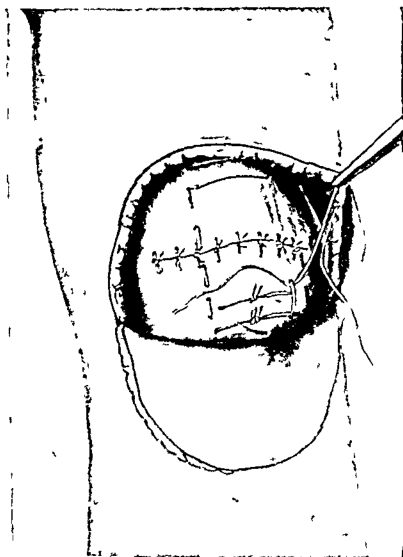


Fig 12 Stay sutures

Fig 13 Case I E S R dio ram showing position of ankylos s before arthroplasty

A

B

Fig 14 Cas I E S End result 5 years ten Months after arth opla ty

B Volu

V . . P

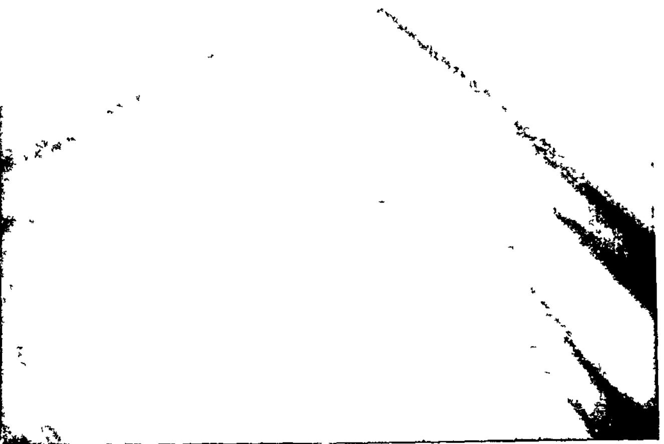


Fig 15 Case I E S Lateral radiogram 5 years ten months after arthroplasty



Fig 16 Case II E. S Radiogram showing ankylosis before arthroplasty



Fig 17 Case II E. S End result 6 and 1/2 years after arthroplasty

A Voluntary flexion B Voluntary extension C Range of motion



Fig 16 Case II E. S Radiogram showing ankylosis before arthroplasty

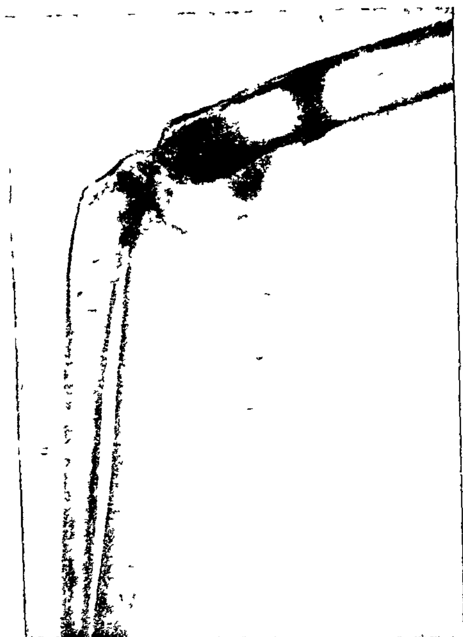


Fig 19 Case III F D End result Vo'intary extension One year four months after arthroplasty



Fig 18 Case III F D End esult 16 Months after arth oplasty

A Volontary exten ion

B Volontary flexion.

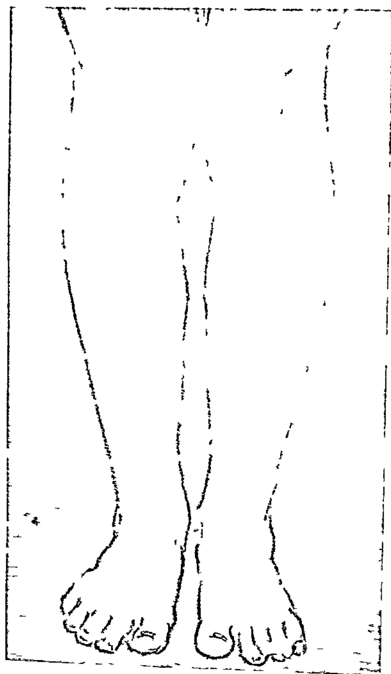


Fig 21 Ankylosis of Knee In good position.

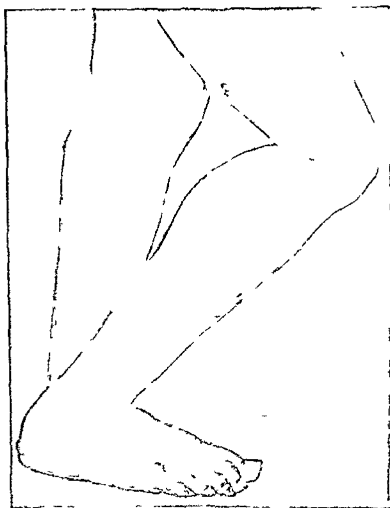


Fig 20 A kylosis of Knee 90 degrees flexion deformity

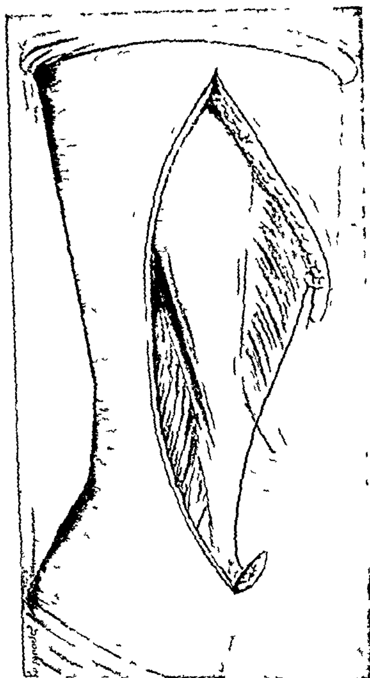
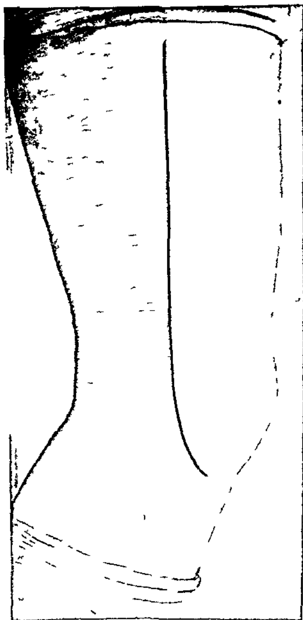


Fig 23 Incision through fascia and capsule including division of the quadriceps tendon



Fi 22 Kocte cision.

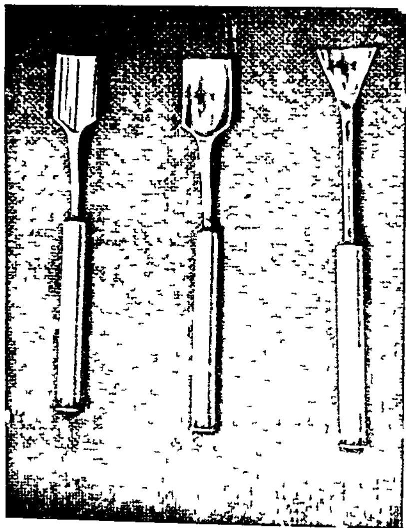


Fig 25 Instruments of Putti

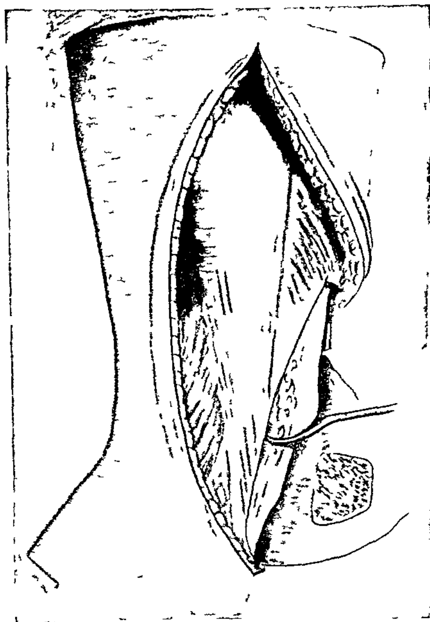


Fig 24 Displacement of the patell with inner capsule inw rd and downward F eeing of the joint line.



Fi 27 Luxation of the joint and remodeling of the femoral and tibial surfaces Note the exaggeration of the spine of the tibia

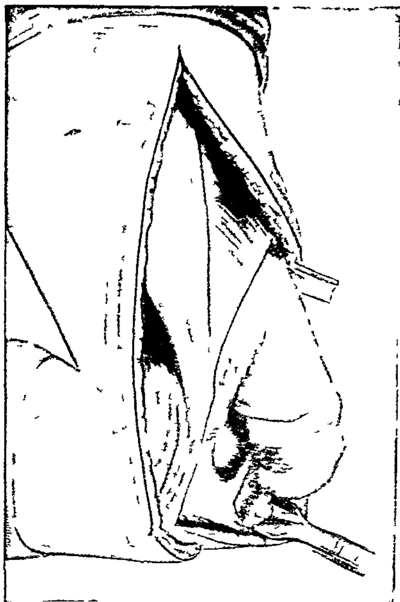


Fig. 26 Lux tion of the joint and remod-l ng of th femoral and tib l surfaces Note the exaggeration of the pin of the tibia.

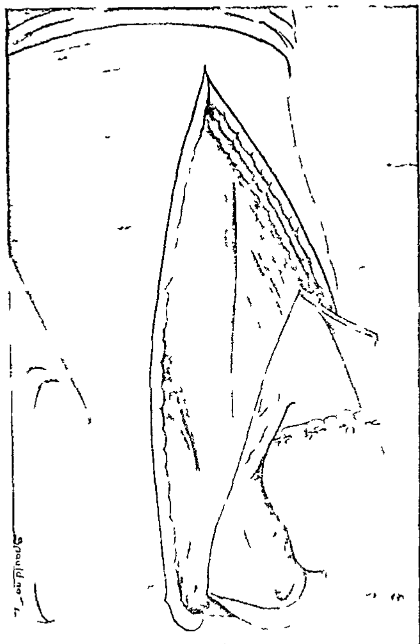
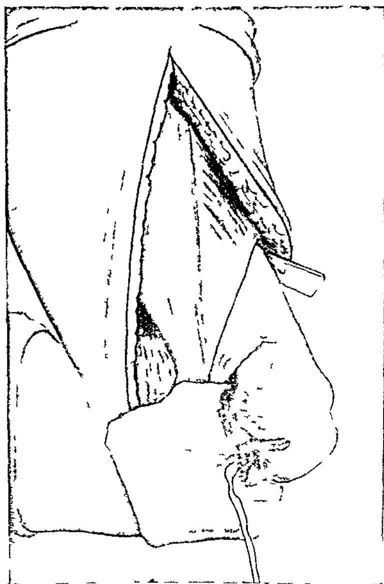


Fig 29 Completion of the suture about f moral end



F 6 23 Attachment of the fascia fl p to the post rior capsule

Figs 31 and 32 Case I F O K 12 years After mobilization — showing weight — bearin

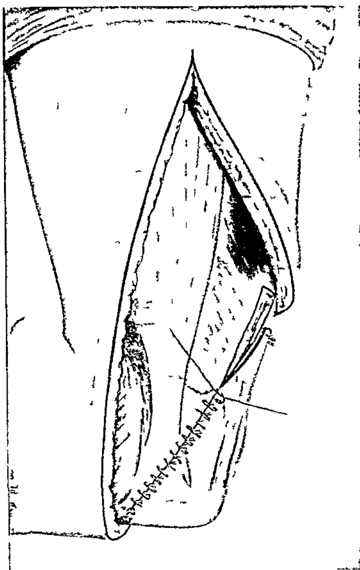


Fig 30 Sutu e of the capsule and elo g ted quad i eps



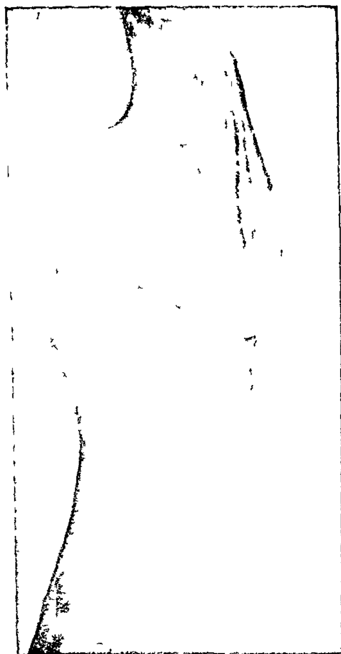
Fig. 34 Case I F O K — A Anteroposterior roentgenogram 12 years after arthroplasty



Fig 33 Case I F O K 95 Fl xion 12 years aft r arth oplasty



Fi 34 Case I F O K — A Anteropostenor roentgenogram 12 years after] arthroplasty



F g 35 Case I F O K — B Later I ro ntgenogram after arthroplasty

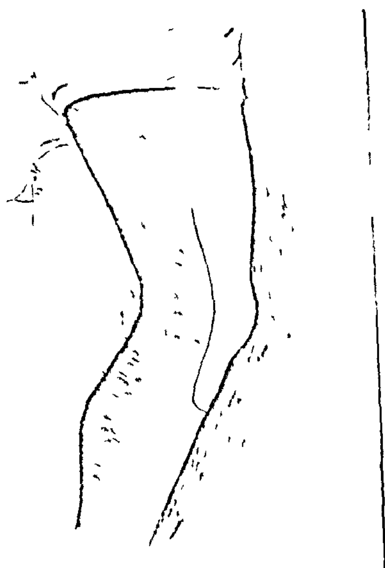


Fig. 30. Line of Kocher's incision. The dotted line [illegible] which is necessary [illegible]

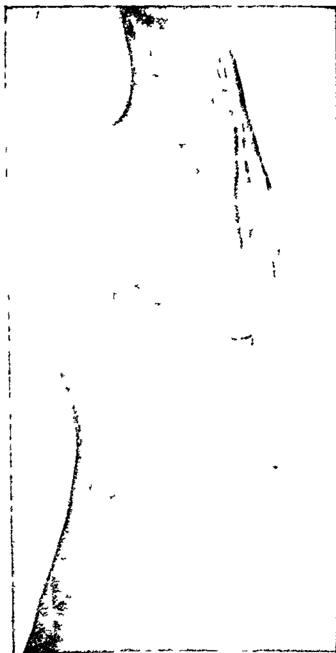


Fig 35 Case I F O K — B Lateral roentg nogram aft arth oplasty

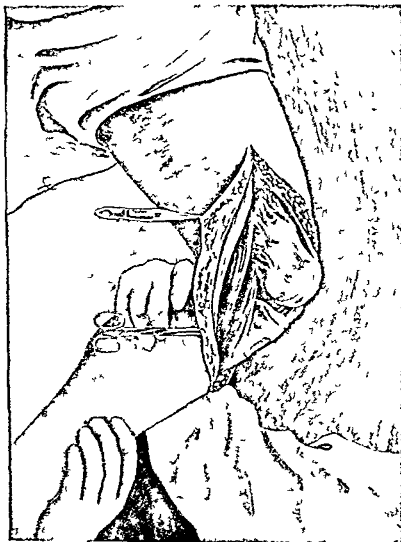


Fig 38 Luxation of the joint surfaces (Putti)

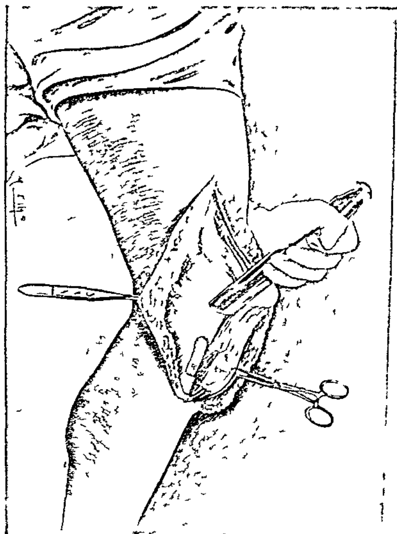


Fig. 37 Detachment of the tibial tubercle and the arthrolysis (Putti)

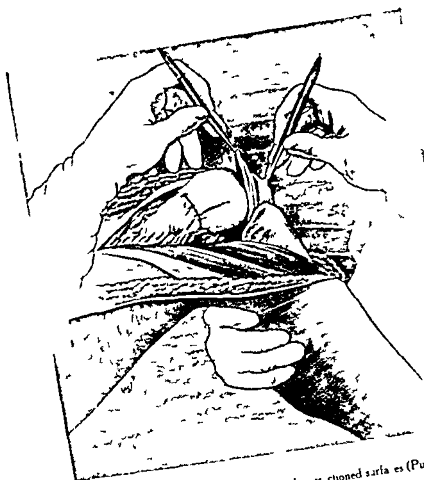


Fig 40 Attachmsnt of the flap on the es chioned surfa es (Putti)

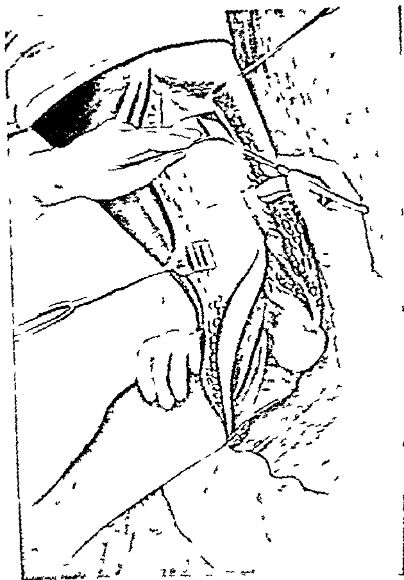
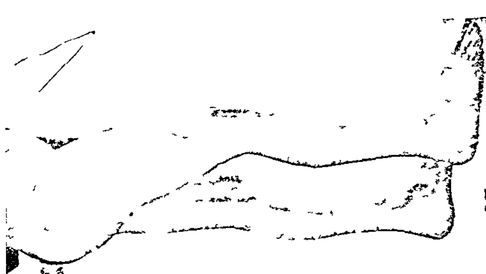


Fig 39 Preparation of the fascia lata flap (Putti)

Figs 43 and 44 After mobilization— showing weight — bearing and active extension (Putti)



Figs 41 and 42 Before mobilization (Putti)



Fig 46 Radiogram taken 27 months after the intervention (Putti)



Fig 4. 8. [illegible] (Putti)

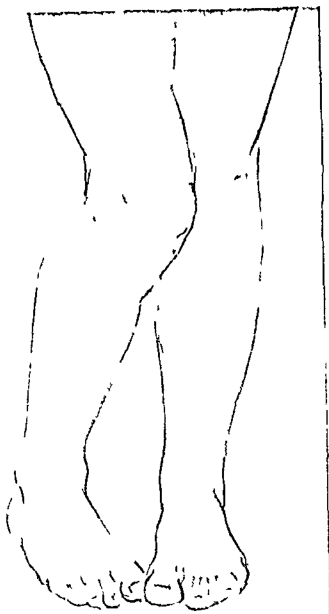


Fig 48 Ankylosis f hip Note flexion adduction and nward otation usually found in this condition *unt eated*

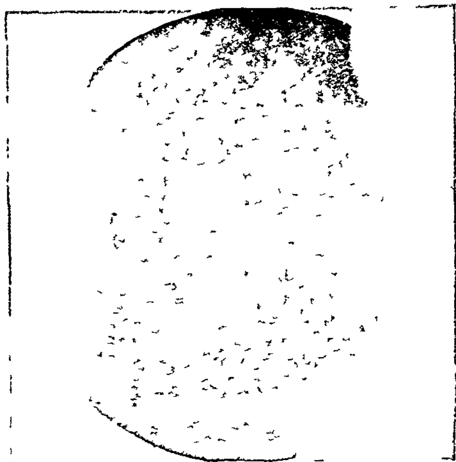


Fig 47 R diogr m t ken 27 month fter the int rvention (Putti)

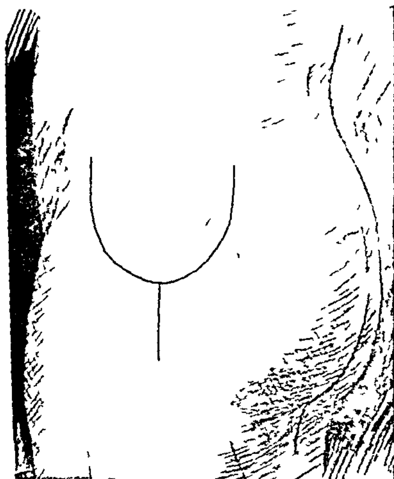


Fig 50 "Goblet" incision through the skin and fascia lata down to the muscles and trochanter The lower tip of the upper flap is placed just below the trochanter The downward prolongation lies along outer surface of the femur (Murphy)

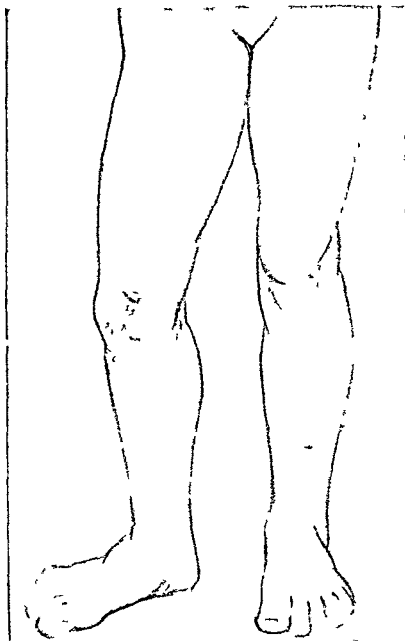


Fig 49 Ankyl sy of h p Note prop posit o — Abdu t on 10 — sl ght fl xion (10) and sl ght external rot t o

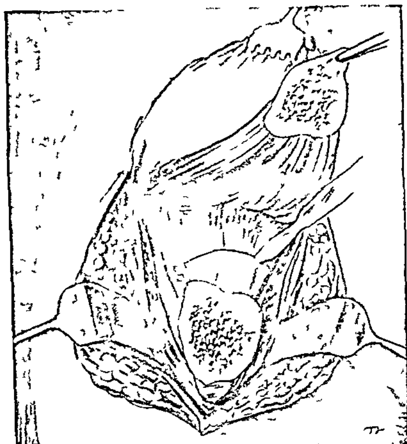


Fig 52 | The trochanter with its attached muscles is drawn upward the anterior fibers of the gluteus medius muscle having been cut The capsule of the joint is being incised at right angles to the direction of its fibers In this operation it was not neccessary to cut either the pyriformis or obturator externus muscles (Murphy)



Fig 51 The fl p of skin fat o fascia lata ha been retracted upward the anterior and posterior borders of the wound are retracted thus exposing generously the great trochanter and its attached muscles She chain-saw is passed on the needle underneath the superior muscles group chiefly the gluteus medius down to the capsule of the joint, and the trochanter with muscles attached is being sawed off in the direction indicated by the dotted line (Murphy)

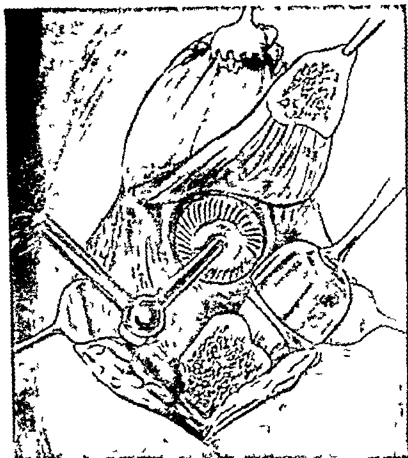


Fig 54 Reshaping and smoothing the head of the femur and the acetabular cavity with D Murphy s end mill and reamers The head of the femur is dislocated backward from the acetabulum preceding this step of the operation (Murphy)

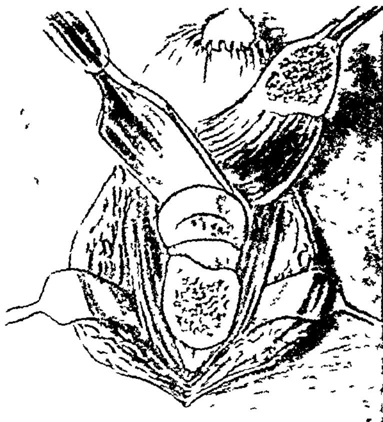


Fig 53 The large guage is being d n betw n the h d of the femur and the acetabulum to di d the bony nkylos betw en the two Note that a guage ha been selected the curve of which fit th   orm l cur e of the head of the femu and the c tabulum o th t th min mum amount of reshap ng is nece s y lt r the divi ion of th e nkylo s (Mu phy)



Fig 56 Preparation from the und r surface of the skin flap of the Murphy pedicled fascia and fat flap for interposition between the freshened ends of the bones The dotted lines indicate the extent of the flap The use of a pedicled and therefore viable flap of fascia and fat interposed between the raw bony surfaces of the newly formed joint is the characteristic feature of *all* of D Murphy s arthroplasty operations (Murphy)

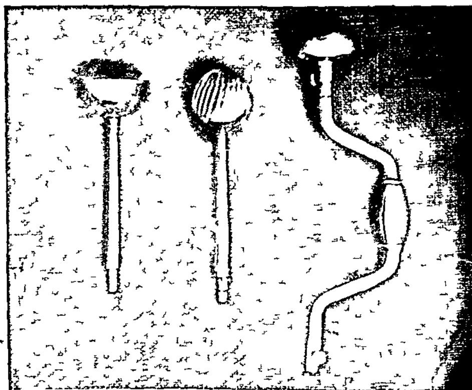


Fig 52 Instrument of Murphy



Fig 56 Preparation from the und r surface of the skin flap of the Murphy pedicled fascia and fat flap for interposition betwe n the freshened ends of the bones The dotted lines indicate the extent of the flap The use of a pedicled and therefore viable flap of fascia and fat interposed between the raw bony surfaces of the newly formed joint is th characteristic feature of *all* of D Murphy s arthroplasty operations (Murphy)



Fig 57 The interposing pedicled fl p of fascia and f t has been passed around the gluteus medius muscles posterior to its attachment, and dropped bown over the acetabulum to the rim of which it has been sutured with chromized catgut. The head of th f mur when replaced will be on this flap (Murphy)



Fig 58 The trochanter has been nailed back in place hand the cut end of the muscles sutured Usually D Murphy uses a continoaus suture of phosphor bronze wire to r unit the muscle The skin is sutured with horse hair and two or three sutures of silkworm gut are inserted if neccessary (Murphy)

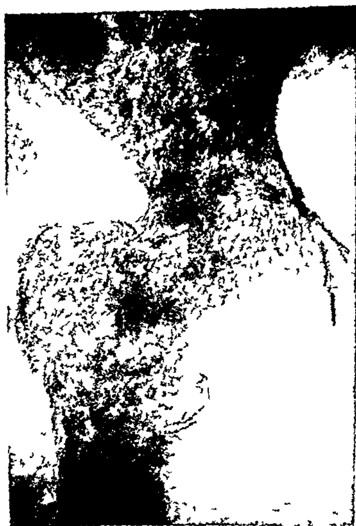


Fig. 59 Complete bony ankylos of l ft hip w th rotation of leg nward nd adduct on beyond pel ic inlet (Murphy)







Figs 60 61 62 Photographs made one year after operation showing that patient has a full normal range of motion in the hip on which the arthroplasty was done (Murphy)

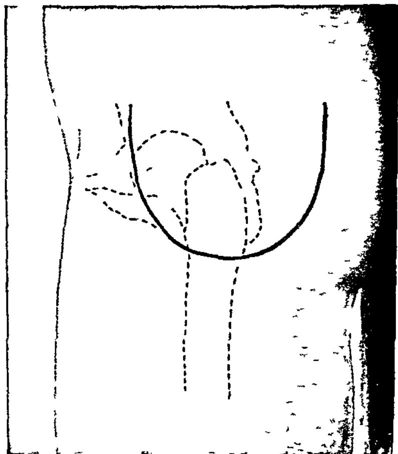


Fig 63 U-sh ped skin nci io

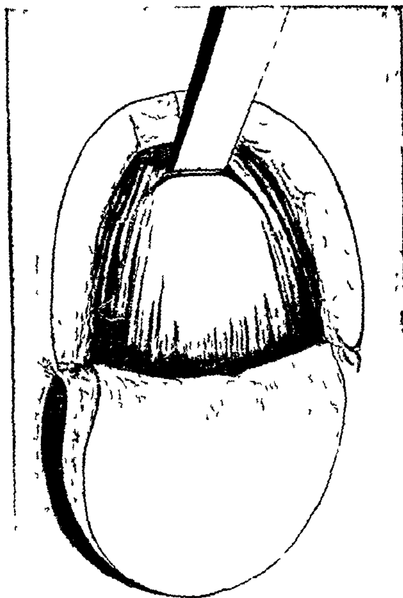


Fig 64 Line of fascia incision preparatory to removal of great trochanter

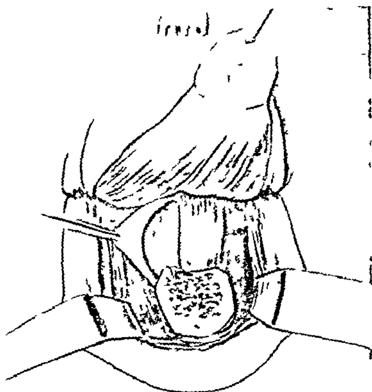
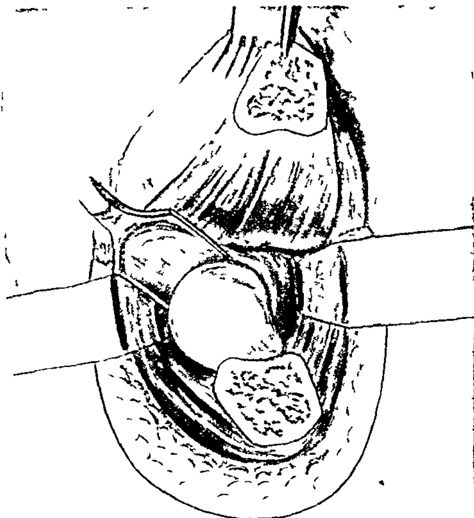


Fig 65 [illegible]



Fi 66 Sepa ation of the fe nur f om the acetabulum

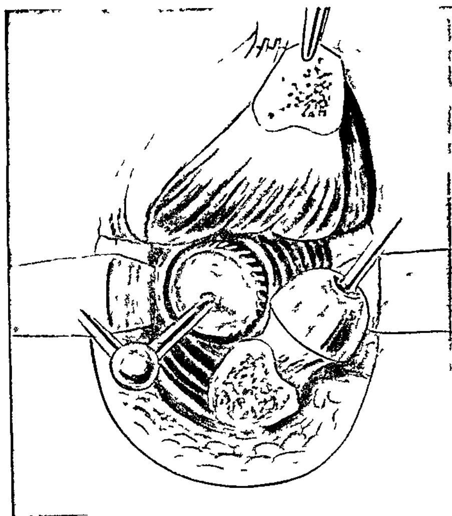


Fig 67 Ream n out of acetabulum and ound ng of head with Mu phy mol and femal a p

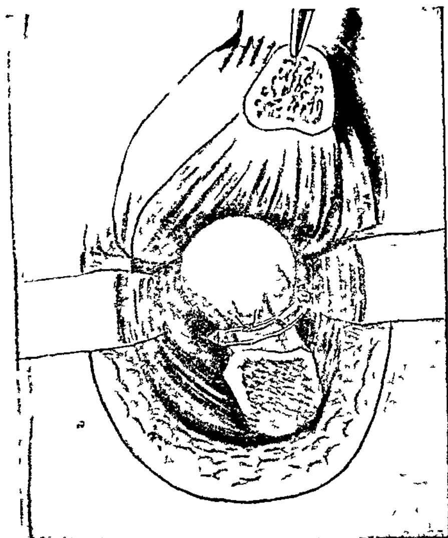
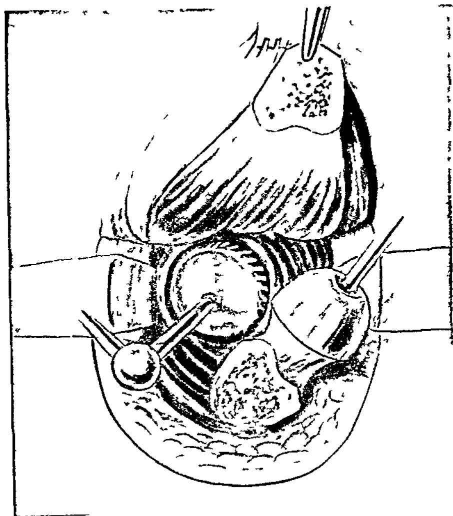


Fig 68 The fascia flap sewed around neck of femur with interrupted sutures and tied with a purse string



Fi 67 R amin out of acetabulum and ounding of he d w th Murphy mol d fem le p

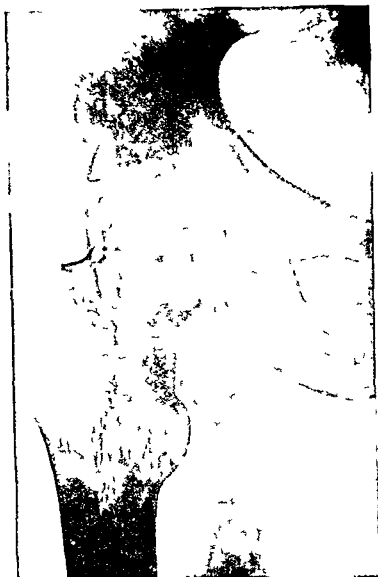
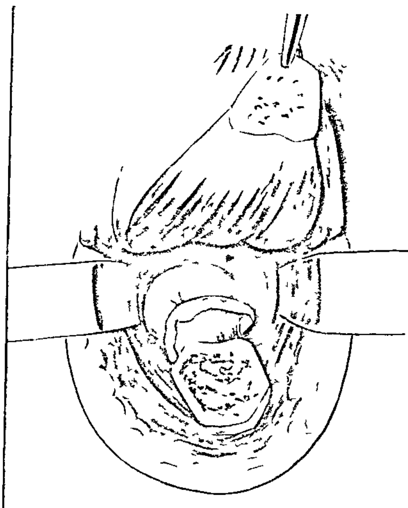


Fig 70 Case II O P Roentgenogram of left hip before arthroplasty Mar 22 1916



F g 69 Red tion of f mo l he d



Fig 70 Case II O P Roentgenogram of left hip before arthroplasty Mar 22 1916



Fig 71 Case I O P Roentgenogram of ight hip before arthroplasty
Mar 22 1916



Fig 72 Case I O P Roentgenogram of right hip 2 1/2 years after arthroplasty Nov 20 1922

se I, O P Voluntary motion in right hip 2 1 2 years aft r arthroplasty (Pati nt has ab ut twice this m ti n but is handicapped in further flexion by double ankylosis of the kn e)



Fig 75 Case II O P Roentgenogram of left hip 2 years after arthroplasty Nov 20 1922

Figs 76 77 Case II O P Voluntary motion in left hip 2 years after arthroplasty (Patient has about twice the motion but is handicapped in further flexion by double ankylosis of the knee)



Fig 79 Cases I and II O P Roentgenogram after arthroplasty Mar 23 1922

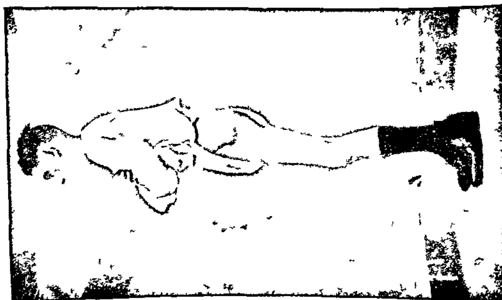


Fig 79 80 C 1 ill O P ... w — t nd g ft throplasty



Fig 81 Cases I et II Antero-postenor view — standing after a throplasty

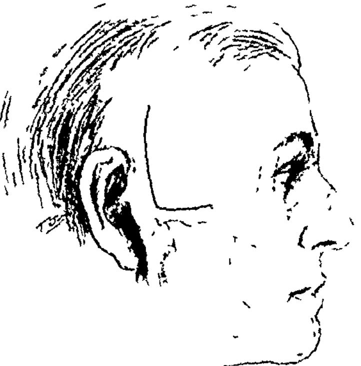


Fig 82 L sh ped skin incision above the zygoma and in front of the ear o placed to avo d injury to the facial nerve

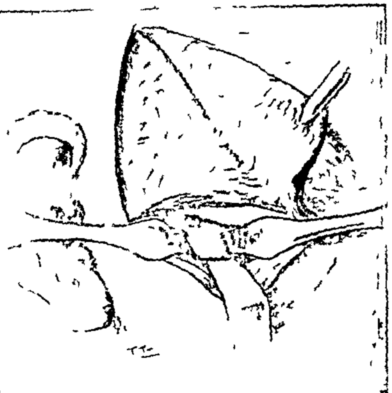


Fig 83 Skin flap r tracted and zygoma and neck of the mandible exposed Two curved periosteal el vators are shown clos ly applied to the posterior su face of the neck of the mandible thus protecting the international maxillary artery from inj ry during division of the bone.

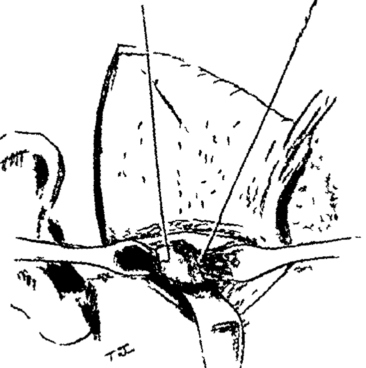


Fig 84 Dividing the neck of the mandible with the Gigli saw In actual operation the saw is not allowed to make so acute an angle as shown in the illustration because of its great tendency to break when sharply bent

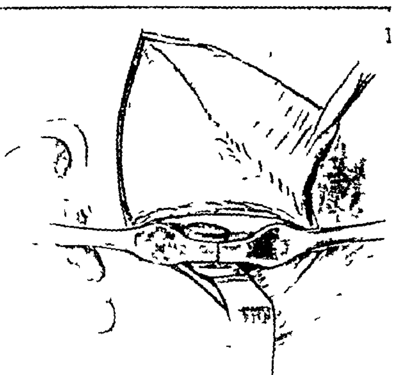


Fig 85 The neck of the mandible has been divided the cut ends of the bone separated by traction on the lower fragment and space thus provided for the interposing fascia and fat flap The curved periosteal elevators still protect the internal maxillary artery from trauma

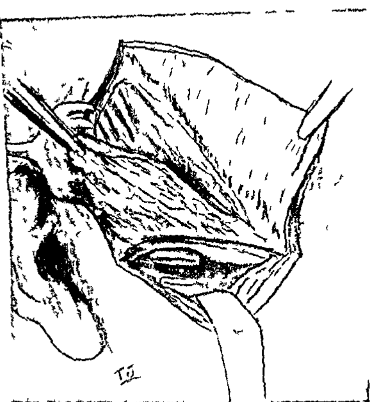


Fig 86 The pedicled *fascia* and fat flap is dissected from the temporal fascia and the free end of the flap is turned inward *between* the divided ends of the mandible and sutured *securely* in place with tacking stitches



Fig 87 The flap is now in place and the *wound ready for* closure

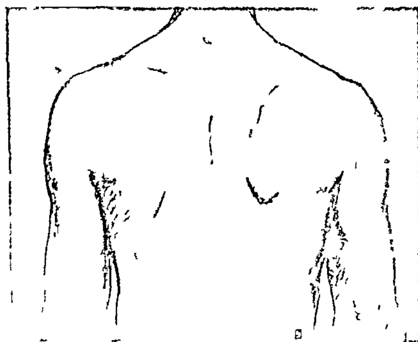


Fig 88 Position of rest note rotation of scapula with full rest position of arm

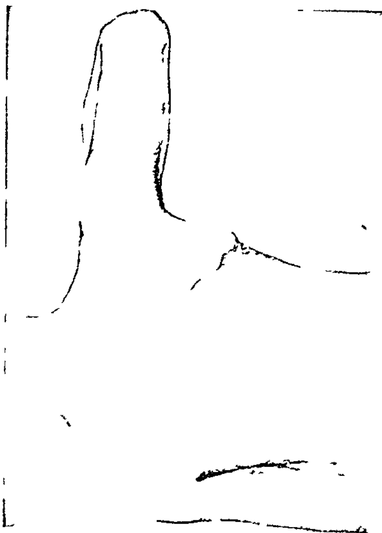


Fig 89 Full abduction obtained by rotation of scapula

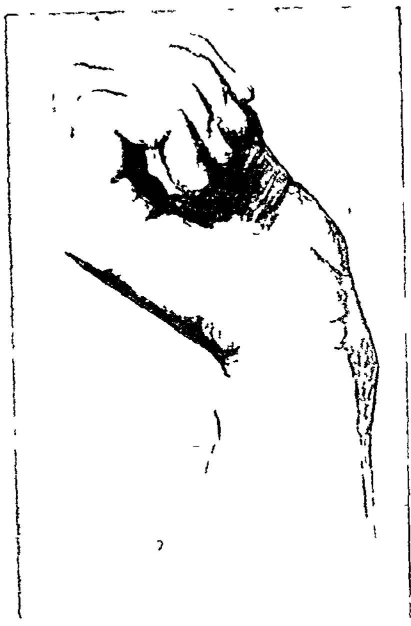


Fig 90 In position of st ength a most important factor in all wrist cases

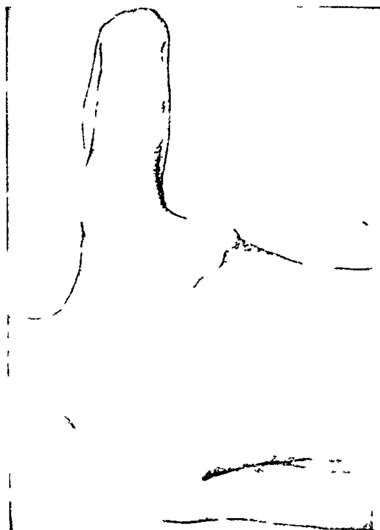


Fig 89 Full abduction obtained by rotation of scapula

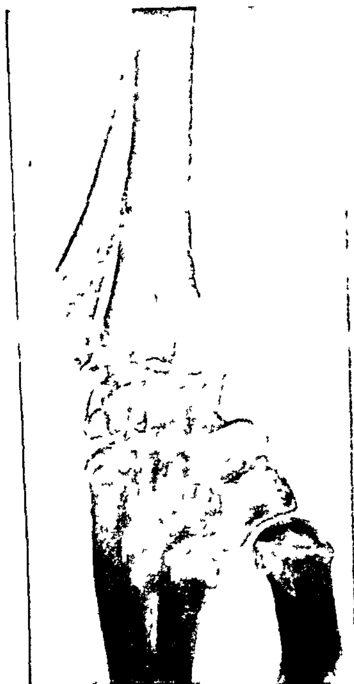


Fig 92 Case I E M Lateral roentgenogram showing ankylosis before arthroplasty July 29 1922



Fig 91 Position of weakness (flexion) note compensatory contraction of phalanges.

Figs 94 95 Case I E M Ankylosis before arthroplasty November 10 1922

MAC AUSLAND

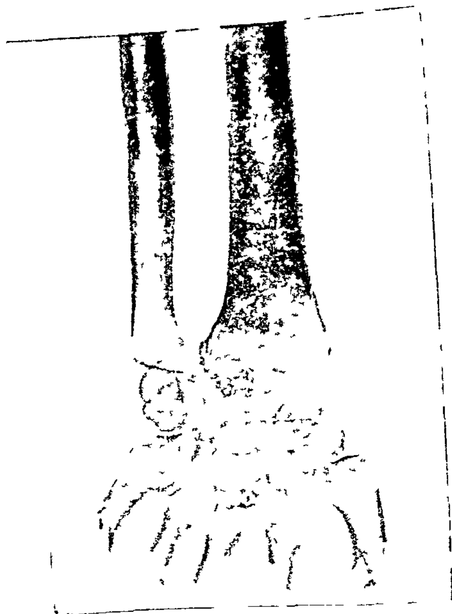


Fig 93 Case I E. M Antero post rio roentge ogr m show ng ankylosis befo e arth oplasty J l. 29 1922.



Fig 97 Case I E. M Antero postenor roentgenogram showing ankylosis after manipulation



Fig 96 Case 1 E. M Roentgenogram showing ankylosis after manipulation

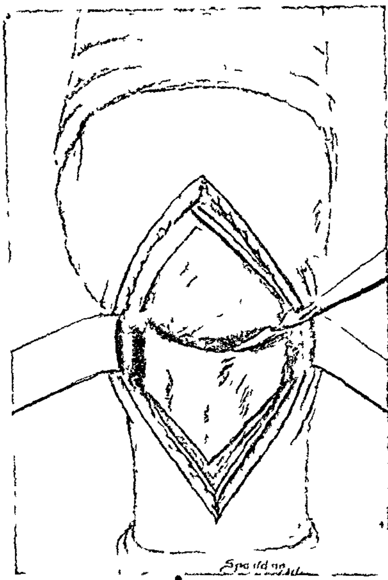


Fig 99 Cutting out the joint line with curved chisel and removal of smal amount of bone

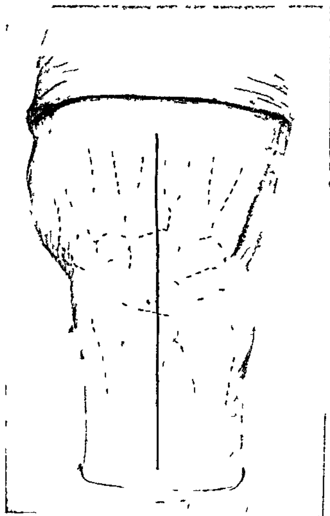


Fig 98 Line of incision

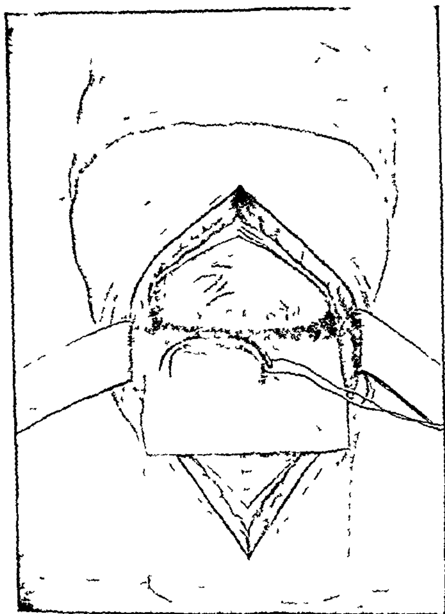


Fig 101 Suture of fascia lata to anterior capsule.



Fig 100 Making convex and conca e surf ce smooth with file.



Fig 103 Case I E M Roentgenogram after arthroplasty (in plaster)

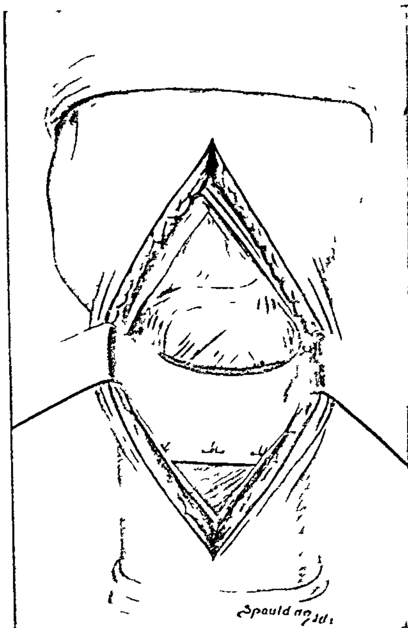


Fig 102 Sut of fascia lata to posterior capsule



Fig 105 Case I E. M Roentgenogram 1 month after arthroplasty



Fig 104 Case I E. M Roentgenogram afte arthroplasty (in plaster)

Fig 111 Excision of small amount of head

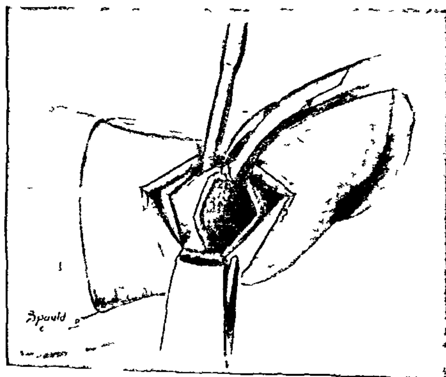


Fig 112 Rounding of distal end of metatarsus

Fig 109 Line of incision.

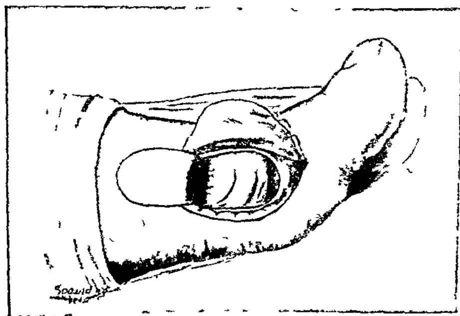


Fig 110 Flap dissected back

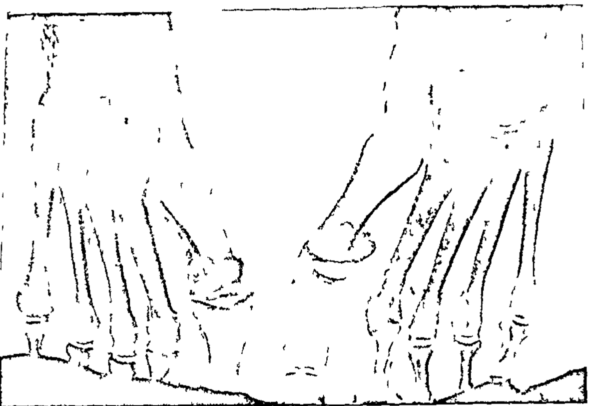


Fig 115 Case I D R Anterorposterior Roentgenogram 20 months after arthroplasty

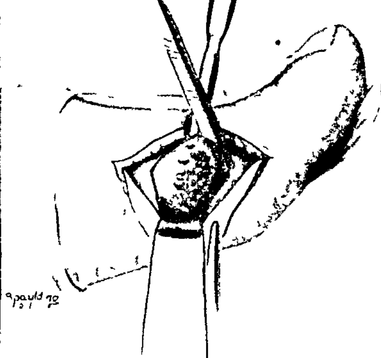


Fig 113 Filing and smoothing of metatarsal shaft.

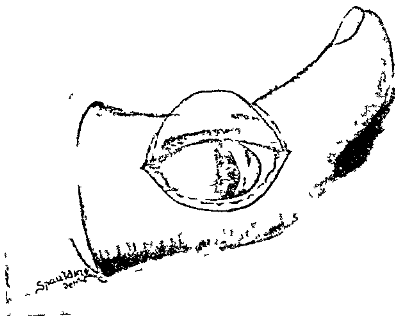


Fig 114 Flap hown in pl ce



Fig 117 Case I D R Toes of l ft foot in [illegible]

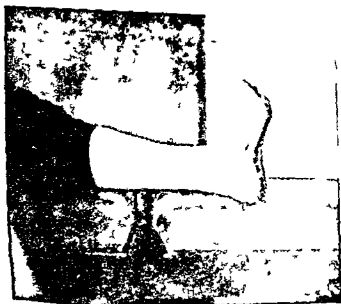


Fig 118 Case I D R To s of l ft foot in plantar fle on 21 months after arthroplasty



Fig 116 Case 1 D R Lateral roentgenogram 20 months after arthroplasty

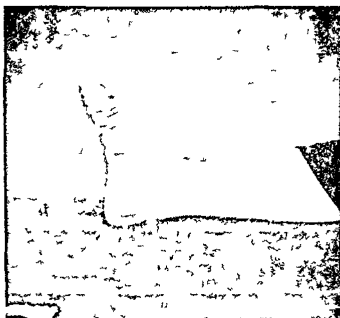


Fig 119 Case I D R Toes of right foot in dorsi flexion 21 months after arthroplasty

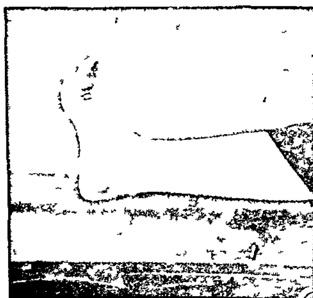


Fig 120 Case I D R Toes of right foot in plantar flexion 21 m th ft rthroplasty